INDUCTEES OF THE NATIONAL INVENTORS HALL OF FAME®

39TH EDITION

Inductees of the National Inventors Hall of Fame

2011

39th Edition

The National Inventors Hall of Fame

The National Inventors Hall of Fame was established in 1973 to honor the individuals who conceived, patented, and advanced the great technological achievements since the birth of our nation. The Hall of Fame is located in Alexandria, Virginia, on the campus of the United States Patent and Trademark Office, a founding partner of the National Inventors Hall of Fame.

Now a supporting organization of Invent Now, Inc., the National Inventors Hall of Fame continues its annual tradition of selecting Inductees through a process that accepts nominations from all sources and relies on a panel of experts in the fields of science, technology, engineering, and patents to screen, vet, and make final selections. The criteria for Induction into the Hall of Fame requires candidates to hold a United States patent that has contributed significantly to the nation's welfare and the advancement of science and useful arts. With the 2011 Class, there are 460 Inductees in the National Inventors Hall of Fame.

Invent Now

Invent Now, Inc., with headquarters in North Canton, Ohio, operates programs that recognize the contributions of our inventive society and stimulate and engage the next generation of creative thinkers and innovators.

Invent Now, Inc. Headquarters, North Canton, Ohio

These programs include:

Camp Invention®, a one-week summer program that engages elementary children to discover their own innate creativity and inventiveness through hands-on science, technology, engineering, and mathematics (STEM) content.

Camp Invention

Club Invention®, an afterschool program that uses invention-themed educational challenges to extend STEM-based learning beyond the school day.

Club Invention

Collegiate Inventors Competition

The **Collegiate Inventors Competition®**, which, as the nation's premier honor for student-driven invention, brings national recognition to university and college students for their groundbreaking patentable research and innovations.

National Inventors Hall of Fame Induction Ceremony

The **National Inventors Hall of Fame® Induction Ceremony**, providing an annual high-profile forum to formally and appropriately recognize and honor Hall of Fame Inductees on a national stage.

National Inventors Hall of Fame and Museum, Alexandria, Virginia

The **National Inventors Hall of Fame and Museum**, featuring changing interactive exhibits that highlight inventors, patents, and trademarks, with special focus on the achievements of Hall of Fame Inductees and the history and growth of America's intellectual property system.

National Inventors Hall of Fame School... Center for Science, Technology, Engineering and Mathematics Learning, Akron, Ohio

The National Inventors Hall of Fame School...Center for STEM Learning, a nationally recognized middle school that uses innovative problem-based learning curricula. The school incorporates Invent Now initiatives like the Visiting Inductee Program, where Hall of Fame Inductees work with students on problem-based learning and the Invent Now Museum, a state of the art multi-media and hands-on exhibit space featuring invention-themed exhibits.

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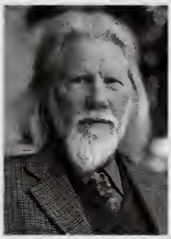
The 2011 Inductees of the National Inventors Hall of Fame

Continuing to celebrate its mission of recognizing and fostering innovation, the National Inventors Hall of Fame presents the 2011 Inductees and their life-changing work. Their inventiveness, determination, and dedication are characteristics to admire and emulate.

George Devol, *Unimate Industrial Robot*
Whitfield Diffie, *Public Key Cryptography*
Martin Hellman, *Public Key Cryptography*
Ralph Merkle, *Public Key Cryptography*
Eric R. Fossum, *CMOS Active Pixel Sensor "Camera-on-a-Chip"*
Gary K. Michelson, *Spinal Surgical Devices*
Steven Sasson, *Digital Camera*
Esther Sans Takeuchi, *Lithium/Silver Vanadium Oxide Battery*
N. Joseph Woodland, *First Optically Scanned Bar Code*
Bernard Silver, *First Optically Scanned Bar Code*


George Devol


Whitfield Diffie


Martin Hellman


Ralph Merkle


Eric Fossum


Gary K. Michelson


Steven Sasson


Esther S. Takeuchi


N. Joseph Woodland


Bernard Silver

Historical Inductees

The 2011 class of Inductees includes 29 historical inventors whose work in the last decades of the 19th century and the first decades of the 20th century provided a foundation for continued and future innovation.

Mary Anderson, *Windshield Wiper*
Thomas Armat, *Motion Picture Projector*
Edwin Binney, *Carbon Black Manufacturing*
George A. Campbell, *Loading Coil*
Albert B. Dick, *Duplicating Machine*
Carleton Ellis, *Margarine*
Hannibal Goodwin, *Transparent Flexible Nitrocellulose Film*
John Hays Hammond, Jr., *Radio Control*
François Hennebique, *Reinforced Concrete Construction*
Peter Cooper Hewitt, *Mercury-vapor Lamp*
Frederick Ives, *Color Photography*
Charles F. Jenkins, *Motion Picture Projector*
Clarence Kemp, *Solar Water Heater*
Henry M. Leland, *Interchangeable Parts for Automobiles*
Stanley Macomber, *Open Web Joist*
Warren Marrison, *Quartz Clock*
Thomas E. Murray, *Early Power Generation*
Eadweard Muybridge, *Stop Action Photography*
Walther H. Nernst, *Metallic Filament Incandescent Lamp*
Henry Phillips, *Phillips Screw*
Valdemar Poulsen, *Magnetic Wire Recorder*
Michael Pupin, *Loading Coil*
James Ritty, *Cash Register*
John Ritty, *Cash Register*
Wallace C. Sabine, *Architectural Acoustics*
Eugene Sullivan, *PYREX® Brand Cookware*
Carl A. von Welsbach, *Improvements to Gas Lighting*
Thomas A. Watson, *Improvements to Telephone*
Rollin Henry White, *Flash Boiler for Generating Steam; Controlled Differential*

1776-1885
Farms to Factories

In its first century, the United States was largely an agricultural nation. Inventors were craftsmen, designing for farming and tool-making needs – a faster means of reaping, a more durable plow, a hotter forge.

The environment for invention started changing in the mid-1800s. Better public education was instituted, the United States Patent Office grew, and a free-enterprise system that rewarded entrepeneurs flourished. As people sought better, faster, and cheaper ways to bring goods to market, a new industrial age roared to life. Building on the power of thousands of mechanical innovations, the United States began its change from an agricultural to an industrial nation. Inventors became an integral part of the new industrial culture.

Photo credit: Courtesy of Howard Steamboat Museum

John Fitch

Propelling Boats with Steam

Patented August 26, 1791

Born January 21, 1743
Died July 2, 1798

Inducted in 2006

John Fitch made the first successful trial of a steamboat in 1787, marking the beginning of steam-powered water travel.

Born in Windsor, Connecticut, Fitch had little formal schooling, having spent his early years working his family's farm. He later was apprenticed to a clockmaker, learned brass working and opened his own brass foundry, tried his hand as a silversmith, and was a supplier to the Continental Army during the American Revolution. After the war, he surveyed the Northwest Territories before beginning his quest to invent a steam-powered boat.

Fitch built a forty-five foot boat that was propelled by twelve steam-powered oars. He successfully demonstrated the boat on the Delaware River in August 1787, and received his first U.S. patent in 1791. In the decade after 1785, Fitch built steamboats propelled by ranked paddles, paddle wheels, and screw propellers.

By 1788, Fitch had launched a steamboat carrying passengers between Philadelphia and New Jersey, and one making regular runs across the Delaware River. But early financial losses, uncertain investors, and a skeptical public prevented commercial success. Nonetheless, Fitch had demonstrated the feasibility of steam navigation, a technology central to American progress in the nineteenth century.

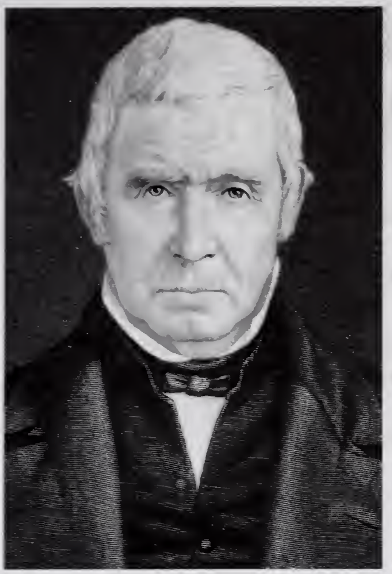


Photo credit: The Connecticut Historical Society, Hartford, Connecticut

Eli Terry

Clock

Patent November 26, 1797

Born April 13, 1772
Died February 24, 1852

Inducted in 2007

A native of East Windsor, Connecticut, Eli Terry had his start in the clock making business in a series of apprenticeships where he manufactured both brass and wooden movement clocks. In 1793, Terry moved to Plymouth, Connecticut, and by the turn of the century, he was dedicated to the production of wooden movement clocks.

Entering into contract with several merchants in 1807, Terry agreed to produce 4,000 wooden clocks within a three-year period. The first year he constructed the necessary machinery to manufacture his clocks, and the second year he produced 1,000 clocks. By developing a process for mass producing the clocks, instead of relying on components that had to be handcrafted, Terry was able to produce the final 3,000 clocks in the third year.

Terry's clock manufacturing techniques and designs made clocks household objects by the 1830s. Previously, clocks were luxury items owned only by the most well off in society. The low cost of Terry's clocks, however, allowed them to permeate all economic and social strata and allowed for the clock to become a ubiquitous addition to the American household.

Photo credit: Corbis-Bettmann

Eli Whitney

Cotton Gin

Patented March 14, 1794

Born December 8, 1765
Died January 8, 1825

Inducted in 1974

American inventor, pioneer, mechanical engineer, and manufacturer Eli Whitney is best remembered as the inventor of the cotton gin. He also affected the industrial development of the United States when, in manufacturing muskets for the government, he translated the concept of interchangeable parts into a manufacturing system, giving birth to the American mass-production concept.

Born in Westboro, Massachusetts, Whitney went to Yale College, graduating in 1792. He saw that a machine to clean the seed from cotton could make the South prosperous and make its inventor rich. He set to work at once and within days had drawn a sketch to explain his idea; ten days later he constructed a crude model that separated fiber seed. In 1794, he received his cotton gin patent.

Whitney's gin brought the South prosperity, but the unwillingness of the planters to pay for its use and the ease with which the gin could be pirated put Whitney's company out of business by 1797. When Congress refused to renew the patent, which expired in 1807, Whitney concluded that "an invention can be so valuable as to be worthless to the inventor." He never patented his later inventions, one of which was a milling machine. His genius as expressed in tools, machines, and technological ideas made the Southern United States dominate in cotton production and the northern states a bastion of industry.

John Stevens

Steam Generator

Patented April 11, 1803

Born 1749
Died March 6, 1838

Inducted in 2006

Independent inventor John Stevens was a pioneer in the development of steam-powered engines used in boats and railroad cars in the early nineteenth century.

Born in New York City, Stevens was educated at King's College, and earned his degree in 1768. After serving in the American Revolutionary War, he took notice of John Fitch's successful steamboat and began working on his own design. By 1791, Stevens had patented a steam engine with an improved vertical boiler.

Over the next ten years, Stevens continued to pursue steam technology. By 1803, he had patented his first successful steamboat design, *Little Juliana,* which used screw propellers and a multi-tubular boiler. Subsequent designs led to *Phoenix,* a larger boat that could easily navigate smaller tributaries.

Beginning in 1810, Stevens pursued the use of steam engines for railroads. To prove the feasibility of steam power, Stevens designed and constructed a steam locomotive, which operated on a circular track on his New Jersey estate. Even though his locomotive did not enter commercial service, it is regarded as the first locomotive built in America.

Stevens' devotion to science and invention led him to work with members of Congress to help draft and pass the first United States Patent Act of 1790.

Photo credit: Hagley Museum and Library

Oliver Evans

High-Pressure Steam Engine

Patented February 14, 1804

Born September 13, 1755
Died April 15, 1819

Inducted in 2001

Oliver Evans, one of America's pioneering inventors, created the high-pressure steam engine and advanced the milling industry by automating flour mills.

Born in Newport, Delaware, Evans was apprenticed to a wheelwright and wagon maker as a teenager. As a young man, Evans ran a flour mill with two of his brothers. Looking for increased efficiency, Evans harnessed the energy of a water wheel and used shafts, gears, and belts to propel mill machinery. In his design, elevators moved grain vertically, conveyers pushed grain horizontally, and hoppers sifted and dried the flour. The final product was flour that was finer, drier, and easier to store.

By the early 1800s, Evans' attention turned to steam power. Although James Watt had already invented the low-pressure steam-engine, Evans' idea was for a high-pressure engine. High-pressure was introduced into a cylinder, causing the piston to push down. Evans also placed the cylinder and the crankshaft at the same end instead of at opposite ends, greatly reducing the overall weight.

Evans had hope for steam-powered land locomotion, but his ideas were ahead of his time. He went on to open the Mars Works in Philadelphia, where he constructed steam engines and boilers for mills, steamboats, and factories.

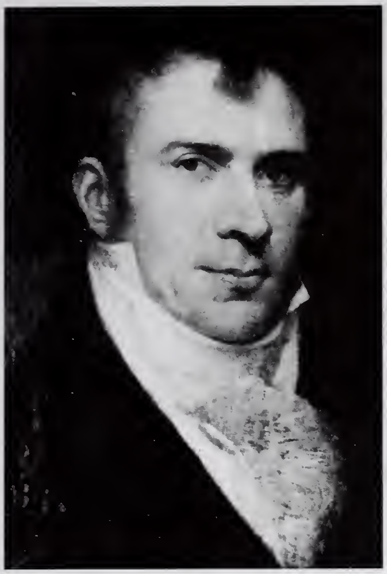


Photo credit: Courtesy of the Library of Congress

Robert Fulton

Steamboat

Patented February 11, 1809

Born November 14, 1765
Died February 24, 1815

Inducted in 2006

Robert Fulton designed and operated the world's first commercially successful steamboat. Fulton's *Clermont* made its historic first run in August 1807 on the Hudson River.

Born in Lancaster, Pennsylvania, Fulton was apprenticed to a jeweler at age fifteen, and worked in England as a portraitist before turning to inventing. In 1802, after a submarine he designed for France's Napoleon failed, Fulton met Robert R. Livingston, a wealthy American statesman fascinated with steamboats. Fulton agreed to build a steamboat that Livingston would finance.

One of many would-be steamboat inventors of his day, Fulton spent months assessing existing ideas and finding the ideal combination that would set his steamboat apart. His first prototype broke in half and sank in 1803. Numerous design changes and additional months' work brought success in 1807.

The *Clermont* carried sixty passengers who each paid five cents per mile. It had a long and narrow hull, two paddle wheels twelve feet in diameter, a twenty-four horse power steam engine designed and built by James Watt, and a twenty-foot copper boiler. Targeting customers willing to pay a premium for speed, Fulton's steamboat earned a handsome profit in its first year and won public acceptance for steamboat travel.

Mary Dixon Kies

Weaving Straw with Silk or Thread

Patented May 5, 1809

Born ca. 1752
Died 1837

Inducted in 2006

Mary Dixon Kies was the first woman to apply for and receive a U.S. patent in her own name. Her patent, issued May 5, 1809, was for a process for weaving straw with silk that was adopted by the New England hat-making industry.

Kies was born in South Killingly, Connecticut. Very little is known about her life or her accomplishments beyond her patented weaving process, which was widely used for over a decade.

Kies' invention was praised by President James Madison's wife Dolly for helping to improve New England's economic situation, which had been hurt by an embargo on goods imported from Europe. New England's hat industry was one of the few industries that continued to prosper during the War of 1812.

Kies' patent, which was destroyed in the Patent Office fire of 1836, was one of only 20 issued to a woman before 1840.

Courtesy: *Springfield Armory NHS*

Thomas Blanchard

Turning Irregular Forms

Patented September 6, 1819

Born June 24, 1788
Died April 16, 1864

Inducted in 2006

Thomas Blanchard devised a machine that transformed gun manufacturing and made the production of many other products faster and less expensive.

Blanchard, born in Sutton Township, Massachusetts, showed an early aptitude for mechanics. He devised an apple-paring machine when he was thirteen, and machines for shearing woolen cloth, and cutting and heading tacks before creating his revolutionary lathe.

In 1819, Blanchard conceived a device with a model attached to a tracing wheel and a raw block of wood attached to a cutting wheel. The tracing wheel followed the contours of the revolving model, while the cutting wheel duplicated the form in the wood block. Originally intended for making gunstocks, the device also eliminated the need to hand-carve shoe lasts, axe handles, hat blocks, wheel spokes, and other irregular forms.

Blanchard was a prolific inventor all his life. To his lathe he added thirteen additional special purpose machines that together formed an early production line. The machines were put into service at both the Springfield and Harpers Ferry federal armories. Blanchard continued to invent into his seventies, and was granted more than two dozen patents for devices ranging from a wood-bending machine to a stern wheel steamboat for ascending rapids.

Photo credit: American Textile History Museum

Samuel Slater

Spinning Machine

Patented 1825

Born June 9, 1768
Died April 21, 1835

Inducted in 2007

Samuel Slater introduced the first water-powered cotton mill to the United States. This invention revolutionized the textile industry and was important for the Industrial Revolution.

Born in Derbyshire, England, to a prosperous farmer, Slater apprenticed at a mill at age 14. Learning all he could about textile production, in 1789 Slater left for the United States to pursue opportunities in the industry there. The U.S. was still largely agricultural and handicraft methods of textile production still prevailed. No U.S. inventor had yet been successful in building a textile spinning machine, and British law prohibited the export of such machines. In an effort to preserve their dominance in the industry, Britain also prohibited the emigration of skilled mechanics. In order to leave the country unnoticed, Slater disguised himself as a farm laborer.

In 1790, Slater built a mill on the Blackstone River in Rhode Island. The Slater mill was the first American factory to successfully produce cotton yarn with water-powered machines. Considered the father of the United States textile industry, Slater eventually built several successful cotton mills in New England and established the town of Slatersville, Rhode Island.

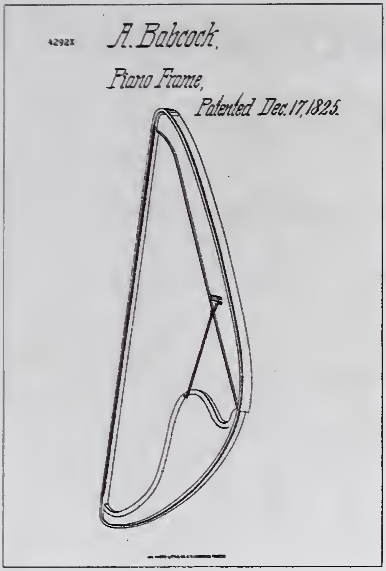


Image of piano frame patent courtesy of the United States Patent and Trademark Office

Alpheus Babcock

Cast-Iron Piano Frame

Patented December 17, 1825

Born September 11, 1785
Died April 3, 1842

Inducted in 2007

The dominance of the American piano industry rested on a key innovation patented by piano builder Alpheus Babcock in 1825. Babcock was the first to develop a one-piece cast iron frame to hold piano strings under tension.

Born in Dorchester, Massachusetts, Babcock was the son of a music teacher. He apprenticed as a piano maker and entered into a partnership with his brother making pianos in Boston by 1810. Through a variety of short-lived companies and partnerships in Boston, Babcock made a reputation for himself as an expert, known for pianos of excellent tone and finish.

Prior to Babcock's design, pianos were made almost entirely from wood. The problem with wood as a material for pianos was two-fold. Its structural weakness prevented high-tension, high-strength strings, which limited the sound a piano could produce. Wood also expanded and contracted in response to temperature and humidity, which de-tuned the piano. Babcock's strong cast-iron frame held big strings made from steel in high tension, permitting bigger and louder instruments, and the iron suffered far less from variations induced by temperature and humidity.

The true dominance of American iron-framed pianos occurred after 1850, when other manufacturers, such as Steinway, utilized an iron frame based on Babcock's design.

Permission to use image by Leslie Caulfield, descendant of Seth Boyden

Seth Boyden

Iron Manufacturing

Patented 1831

Born November 17, 1788
Died March 31, 1870

Inducted in 2006

Seth Boyden invented a process for making malleable cast iron, a tough, bendable, and machinable material that was not hard or brittle like earlier cast irons.

Born on a farm in Foxborough, Massachusetts, Boyden learned the blacksmith trade as a young man, and became a skillful mechanic. He invented machines for cutting files and making nails by age 21, and went on to improve the leather-splitting machine before moving to Newark, New Jersey in 1813. Boyden's inventiveness aided the growth of several Newark industries.

In 1819, Boyden successfully duplicated the undisclosed European process for applying lacquer to leather and set up the first U.S. factory for making "patent" leather. In 1826, after a six-year effort to unlock the secrets of another European product, Boyden produced his first malleable iron casting. Two years later, the Franklin Institute honored him for that achievement.

Boyden later built locomotives, stationary steam engines, and furnace grates. His process for manufacturing zinc oxide for furnaces became known as the "American Process." His other inventions included a hat-forming machine and an inexpensive process for manufacturing sheet iron. Boyden also is credited with producing the first daguerreotype in the United States.

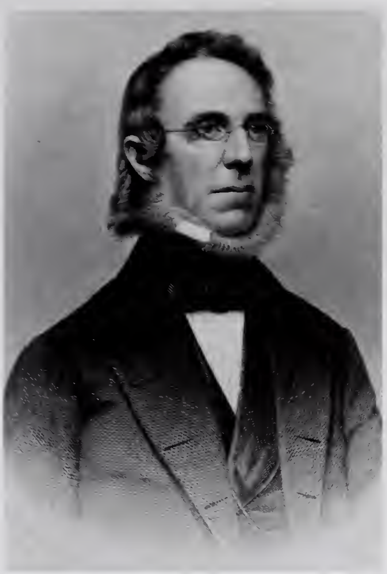


Photo credit: Courtesy of the Library of Congress

Peter Cooper

Steam-Boiler Fire-Box

Patented October 13, 1831

Born February 12, 1791
Died April 4, 1883

Inducted in 2006

Peter Cooper designed and built the engine for one of America's earliest steam locomotives. A prolific inventor, successful businessman, and philanthropist, he also fueled technological progress by founding the Cooper Union for the Advancement of Science and Art.

Cooper was born in New York City and had only one year of formal schooling. Apprenticed to a coach maker as a teen, he invented a machine for shaping wheel hubs. After several other inventions, Cooper patented a rotary steam engine and produced *Tom Thumb*, the first American-built steam locomotive to operate in regular service. Despite its small size, *Tom Thumb* proved a steam-powered locomotive could pull a load at a reasonable speed over winding, graded track.

Cooper also helped develop New Jersey's iron industry. In 1854, his factory produced the first structural iron beams for fireproof buildings. The Iron and Steel Institute of Great Britain awarded Cooper the Bessemer Gold Medal for his many advancements in the field.

Believing that education should be "as free as water and air," Cooper founded Cooper Union, the nation's first free institution of higher learning, in 1859. Cooper Union offered courses in general science, engineering, chemistry, and art and design. It remains a full-scholarship college today.

Photo credit: *Courtesy --Navistar International Corporation-- Archives*

Cyrus McCormick

Improvement in Machines for Reaping Small Grain

Patented June 21, 1834

Born February 15, 1809
Died May 13, 1884

Inducted in 1976

Cyrus Hall McCormick invented the mechanical reaper, which combined all the steps that earlier harvesting machines had performed separately. His time-saving invention allowed farmers to more than double their crop size and spurred innovations in farm machinery.

Born in Rockbridge County, Virginia, McCormick derived his interest in invention from his father, a Virginia landowner who patented several improved farming implements and worked without success for many years to perfect a mechanical reaper. In July 1831, McCormick succeeded where his father had failed, producing a model reaper with all the essential components of later commercial machines. Patenting his invention in 1834, after Obed Hussey had announced in 1833 the construction of a reaper of his own, McCormick started to manufacture the machine on the family estate in 1837. Six years later he began to license its manufacture in other parts of the country. In 1874 he set up a factory in Chicago, founding what eventually became one of the greatest industrial establishments in the United States.

An astute businessman, McCormick increased his sales with door-to-door canvassing and written guarantees for his ready-to-assemble machinery. McCormick amassed a large fortune and invested widely in later years in railroad and mining enterprises.

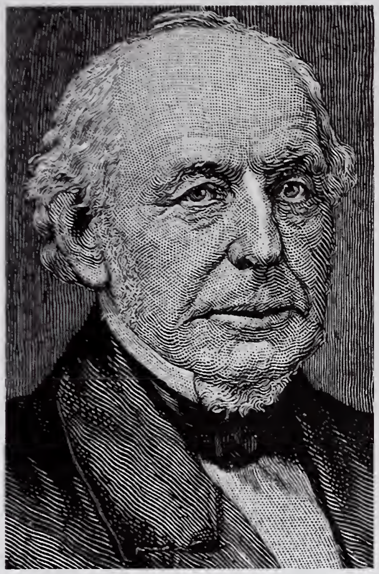


Photo credit: Railroad Museum of Pennsylvania (PHMC)

Matthias Baldwin

Locomotive Engine

Patented September 10, 1834

Born November 10, 1795
Died September 7, 1886

Inducted in 2005

Matthias Baldwin was the first American to build steam locomotives of the same quality as were made in Europe. His company did much to establish railroads in America.

Born in Elizabethtown, New Jersey, Baldwin began his career as a printer, engraver and bookbinder. After he invented an improved process for printing calico, a member of the Philadelphia Museum approached him about the lack of Americans able to build locomotives. He responded by building a small four-passenger demonstration locomotive for the museum.

His full-scale locomotive, *Old Ironsides*, was the first locomotive to carry passengers. Baldwin invented a series of improvements, including a high-pressure steam engine that was much more powerful than prior engines.

The Baldwin Locomotive Works produced more than 1,500 locomotives by the time of his death. Most of Baldwin's railroad equipment was sold in America, although some were also sold across Europe and South America.

During his lifetime Baldwin was known as a supporter of many progressive causes. Before the Civil War, he was an outspoken advocate for racial equality. He built churches, supported the arts, and raised money to care for wounded veterans.

Photo credit: Wadsworth Atheneum Museum of Art, Hartford, CT. Gift of Mrs. Henry K.W. Welch

Samuel Colt

Improvement in Fire-Arms

Patented February 25, 1836

Born July 19, 1814
Died January 10, 1862

Inducted in 2006

Although Samuel Colt is known for his innovative revolver, his technological contributions provided the foundation for large-scale growth of the firearms industry.

Born in Hartford, Connecticut, Colt began developing pistols at a young age. In his revolver design, bullets were loaded into the chambers of a cylinder that was rotated by a pawl and locked into place when the hammer was cocked. Only in his teens, Colt began manufacturing and patenting the first repeating pistol, dubbed the Colt revolver.

The U.S. Army ordered one thousand revolvers after the pistol was used successfully during the Mexican-American War. Colt established the Colt Patent Arms Company to accommodate the mass production of gun parts using steam-powered, belt-driven machines. Stationed along a chorus line of machines, each person worked on a single part. All components produced by the machines were then assembled elsewhere in the factory. His method saved time and money while creating guns with interchangeable parts. Historians regard Colt's Hartford gun factory as a prototype for America's Industrial Revolution.

The firearms company Colt founded was later integrated into Colt Industries, a large multinational conglomerate that still manufactures weapons in its Hartford armory.

Photo credit: Courtesy, American Antiquarian Society

Erastus B. Bigelow

Power-Loom for Weaving Coach-Lace and Other Similar Fabrics

Patent No. 169

Born April 2, 1814
Died December 6, 1879

Inducted in 2006

Over the course of several decades, Erastus Bigelow invented a series of faster, more capable power looms that made rugs and carpets more affordable. Once accessible only to the wealthy, Bigelow's inventions enabled many more consumers to enjoy the comfort of heavy textiles in their homes.

Bigelow was born near Worcester, Massachusetts. His first invention, an 1837 power loom used to make coach lace, contained the essential elements of his later designs. His looms were immediately successful, and he formed the Clinton Corporation in 1838 to build and operate the machines. Within one year of the introduction of Bigelow's loom, production of carpets in the United States had doubled. Recognized during his lifetime as the inventor of all the basic machinery for carpet and tapestry weaving, Bigelow continually improved his designs, and eventually received 35 patents.

Bigelow also contributed to the advancement of scientific education. He was a member of the 1861 committee that was instrumental in the founding of the Massachusetts Institute of Technology. In addition, he published writings on economic principles and was nominated, but not elected, for Senator to the United States Congress.

Photo credit: Courtesy of the Mariners' Museum, Newport News, VA

John Ericsson

Propelling Steam Vessels

Patent No. 588

Born July 31, 1803
Died March 8, 1889

Inducted in 1993

John Ericsson invented the ship propeller and incorporated the landmark device into his design for the Civil War ironclad the *Monitor*. Born in the Swedish province of Vermland, Ericsson first worked helping plan a Swedish canal. While working on the canal, he was tutored in math and the sciences. He joined the Swedish Army at the age of 17 and did topographical surveying.

In 1826 he moved to London, where he showed the breadth of his engineering genius by developing or improving transmission of power by compressed air, new types of steam boilers, condensers for marine steam engines (so ships could travel farther), warship engines below the water line (for protection against shell fire), the steam fire-engine, a steam locomotive, an apparatus that made salt from brine, superheated steam engines, and the flame or "caloric" engine. Ericsson's most enduring invention was the screw propeller, which is still the main form of marine propulsion.

In 1839 he introduced propellers to vessels on the canals and inland waterways and commenced building a "big frigate" for the U.S. Navy. He designed and built the *Monitor* for the Union Navy in 100 working days. It demonstrated its superior design by defeating the Confederate *Merrimac*.

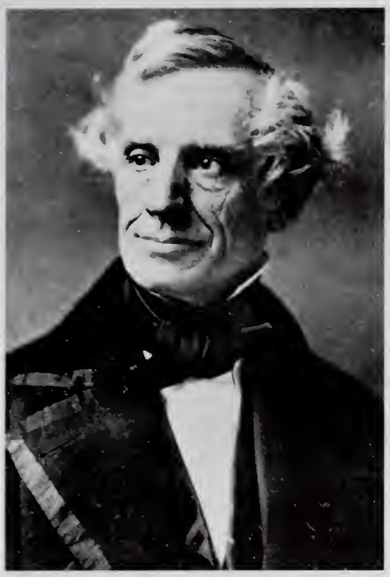


Photo credit: Western Union

Samuel F. B. Morse

Improvement in the Mode of Communicating Information by Signals by the Application of Electro-Magnetism

Patent No. 1,647

Born April 27, 1791
Died April 2, 1872

Inducted in 1975

Samuel F.B. Morse, once a portrait painter, turned to inventing to make his fortune. Morse had little training in electricity but realized that pulses of electrical current could convey information over wires.

Born in Charlestown, Massachusetts, the eldest child of the Reverend Jedidiah Morse and his wife, Elizabeth Ann Breese, Samuel Morse attended Phillips Academy in Andover, Massachusetts, and entered Yale College in 1805, graduating in 1810. Morse took out three patents on pumps in 1817 with his brother, Sidney Edwards Morse. Samuel Morse's interest in telegraphy began in 1832, and the elements of a relay system were worked out late in 1835. The equipment was gradually improved and was demonstrated in 1837. Morse developed "lightning wires" and "Morse code," an electronic alphabet that could carry messages. The patent was applied for in 1840. A line was constructed between Baltimore and Washington, D.C. and the first message, sent on May 24, 1844, was "What hath God wrought!"

To support himself later in life Morse was largely dependent on dividends from telegraph companies. In 1858 several European countries combined to pay a gratuity of 400,000 francs as compensation for their use of his system. In 1861 the two coasts of the United States were linked by telegraph.

Photo credit: Courtesy of the Library of Congress [LC-USZ62-16257

Squire Whipple

Iron Truss Bridge

Patent No. 2,064

Born September 16, 1804
Died March 15, 1888

Inducted in 2007

Squire Whipple's work on iron bridges contributed towards the development of the railroad industry in the United States.

Born in Hardwick, Massachusetts, Whipple received a Bachelor of Arts degree from Union College in Schenectady, New York in 1830. During his early career, he was employed at railroad companies such as the Baltimore and Ohio and the New York and Erie Railroads.

Whipple realized that the newly widened Erie Canal would need not only new bridges to replace existing decaying wooden structures, but also ones that required larger spans. He received his patent for an iron bridge in 1841. A particularly important aspect of Whipple's bridge design was his use of wrought and cast iron members, the former to support tensile loads and the latter for compressive loads. Using two types of iron lowered the cost, as wrought iron was an expensive material.

During the next two decades, over 100 iron bridges built to Whipple's design would span across the Erie Canal as well as other canals and railroad lines. Whipple would later develop other bridge designs, including the "Whipple Trapezoidal Truss," arguably his most famous design, and a drawbridge across the Erie Canal in Utica, New York in 1873.

Photo credit: Print and Picture Collection, Free Library of Philadelphia

Richard Hoe

Double-Cylinder Printing-Press

Patent No. 2,629

Born September 12, 1812
Died June 7, 1886

Inducted in 2006

Richard Hoe's advanced printing technology allowed for the development of the first mass media.

Born in New York City, Hoe was the son of Robert Hoe, a British-born printer who improved the cylinder press developed by David Napier.
In 1827, at the age of fifteen, Hoe left school to join his father's printing firm, R. Hoe & Company. Within fifteen years, he took over the company and began working on a new press that discarded the traditional flatbed and attached the type to a central cylinder, around which revolved four to ten impression cylinders. This became known as the rotary press -- the first in the world.

Also referred to as the "lightning press," Hoe's invention was first introduced to the printing industry in 1847 in the offices of the *Philadelphia Public Ledger*. The resulting eight thousand papers per hour revolutionized newspaper printing. Eager to further improve his press, he eliminated single sheet printing by devising a rotary-web printing press in 1871. This press was fed continuous rolls of papers (or webs), and printed on both sides in one move. The *New York Tribune* was the first newspaper printed with this process.

Hoe's subsequent additions and various updates of high-speed folding apparatus virtually completed the modern newspaper press by 1875.

Photo credit: The Goodyear Tire & Rubber Company

Charles Goodyear

Improvements in India-Rubber Fabrics

Patent No. 3,633

Born December 29, 1800
Died July 1, 1860

Inducted in 1976

Natural or India rubber, as it was once known, was of limited usefulness to industry. Rubber products melted in hot weather, froze and cracked in cold, and adhered to virtually everything until the day in the mid-19th century when inventor Charles Goodyear accidentally dropped some rubber mixed with sulfur on a hot stove. Goodyear's discovery, which came to be known as vulcanization, strengthened rubber so it could be applied to a vast variety of industrial uses, including, eventually, automobile tires.

Goodyear was born in New Haven, Connecticut. He entered the hardware business with his father but the venture failed in 1830. Thereafter he turned his talents to the commercial improvement of India rubber, which, until his time, was not used much in industry because of the adhesiveness of the surface and because of its inability to withstand temperature extremes. After numerous experiments, in 1836 Goodyear developed a nitric acid treatment which partially remedied these defects.

The famous vulcanizing process, patented in 1844, was to revolutionize the rubber industry, but Goodyear was unable to profit financially from his discovery. His numerous patents were constantly infringed, and although he was able to establish his rights legally, he died a poor man.

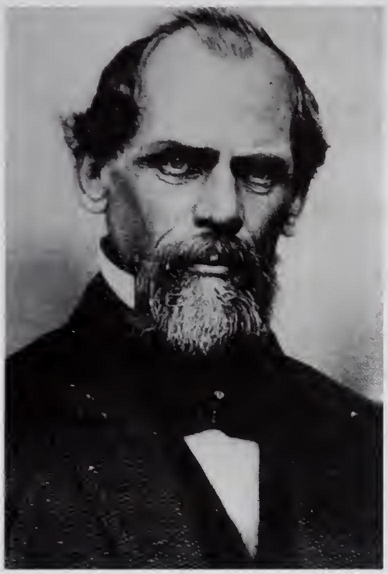


Photo credit: Courtesy of the Butler Eagle and the Butler County Historical Society, Butler, PA

John Roebling

Anchoring Suspension-Chains for Bridges

Patent No. 4,710

Born June 12, 1806
Died July 22, 1869

Inducted in 2004

In 1841, John Roebling invented a wire rope in order to improve upon the bulkier and weaker hemp fiber rope being used to haul canal boats along the Allegheny Portage Railroad between the eastern and western sections of the Pennsylvania Canal. Roebling also developed a technique for spinning cables in place rather than constructing pre-fabricated cables that required maintenance before actually being used.

In 1844-45, Roebling built his first structure using his invention, a wooden canal aqueduct across the Allegheny River. In 1845-46, he built his first suspension bridge to carry a highway across the Monongahela River. He cemented his reputation as the premier builder of suspension bridges in the U.S. with the construction of a railroad suspension bridge at Niagara Falls (1851-55). Roebling was contracted as chief engineer for construction of the Brooklyn Bridge, the project with which he is most popularly associated. However, as work was about to begin, he suffered an accident that led to his death. Construction of the bridge was completed under the supervision of his son, Washington.

Roebling was born in Muhlhausen, Germany. He studied civil engineering at the Royal Polytechnic Institute in Berlin. He immigrated to the United States in 1830 and became a citizen in 1837.

Photo credit: Library of Congress, Prints and Photographs Division, FSA/OWI Collection [LC-USZ61-96]

Elias Howe

Sewing Machine

Patent No. 4,750

Born July 9, 1819
Died October 3, 1867

Inducted in 2004

Elias Howe invented the first practical sewing machine. Born in Spencer, Massachusetts, he spent his childhood and early adult years in Massachusetts. He became a skilled machinist, apprenticing in a textile factory and then for a master mechanic. By April 1845, Howe had created a practical sewing machine. In a public demonstration, Howe's invention proved to be five times faster than the swiftest hand sewers.

Howe was unsuccessful marketing his invention in the United States. In 1846, he went to England and he sold the British rights for the machine to William Thomas, a large manufacturer of corsets, shoes, and umbrellas. Upon his return to the U.S., Howe found that some manufacturers, including Isaac Singer, had already begun to make and sell sewing machines similar to his. A five-year legal battle ensued, lasting from 1849 to 1854. Finally his patent was declared basic and he was awarded a royalty on every machine that infringed his patent.

In 1865, he established the Howe Machine Company of Bridgeport, Connecticut, and the machine that he produced there won the gold medal at the Paris Exhibition of 1867.

Photo credit: Louisiana State Museum. Gift of Dr. C.A. Browne

Norbert Rillieux

Evaporating Pan

Patent No. 4,879

Born March 17, 1806
Died October 8, 1894

Inducted in 2004

Norbert Rillieux revolutionized the sugar industry by inventing a refining process, evaporation in multiple effect, that is still in use today not only for the production of sugar, but also of soap, gelatin, condensed milk, and glue, as well as for the recovery of waste liquids in factories and distilleries.

Rillieux's system, in which a series of vacuum pans heat one another in sequence, had immediate impacts. First, it replaced a dangerous, labor-intensive process known as the "Jamaican Train," in which slaves were required to transfer boiling cane juice from one cauldron to another. The new process also produced a higher-quality product while using less fuel. These improvements in efficiency catapulted the U.S. into a leading role in global sugar production and helped transform sugar from a luxury item to a commonplace one.

Norbert Rillieux was born in New Orleans, the son of a white engineer and a freed slave. He studied applied mechanics at the Ecole Centrale in Paris, but returned to New Orleans in the 1830s. As the status of free blacks deteriorated in the South, he went back to Paris, where he lived until his death. In 2002, the American Chemical Society designated the invention of the multiple-effect evaporator under vacuum a National Historic Chemical Landmark.

Photo credit: Courtesy of Smithsonian Institution Libraries, Washington, D.C.

Walter Hunt

Dress-Pin

Patent No. 6,281

Born July 29, 1796
Died June 8, 1859

Inducted in 2006

Walter Hunt invented the safety pin substantially as we know it today. His improved pin design included a clasp that covered the point and kept it from opening, and a circular twist at the bend to act as a spring and hold it in place.

Hunt was born in upstate New York. After earning a degree in masonry, he worked as a farmer in the mill town of Lowville and devised more efficient machinery for local mills. He received his first patent in 1826. After moving to New York City, Hunt was granted patents for several devices, including a rope-making machine, fountain pen, and repeating rifle. In 1833, he invented the first workable sewing machine. It was well-received by the public, but Hunt never obtained a patent and was reluctant to take the financial risk to manufacture it.

The design for a better safety pin came to the inventor as he twisted an ordinary piece of wire while worrying about a $15 debt. Hunt sold his patent rights for the safety pin and repaid the debt with money left over, but realized only a tiny fraction of the wealth his invention generated.

Hunt continued to invent for the rest of his life. Although he sold the rights to most of his patents, letting others reap their financial benefits, he was well respected and recognized as a prolific innovator at the time of his death.

Photo credit: Newington Cropsey Foundation

James Bogardus

Construction of the Frame, Roof, and Floor of Iron Buildings

Patent No. 7,337

Born March 14, 1800
Died April 13, 1874

Inducted in 2007

James Bogardus significantly advanced American architecture by designing and constructing buildings that combined structural strength and aesthetic beauty.

Born in Catskill, New York, Bogardus was apprenticed to a local watchmaker as a teenager and quickly developed an aptitude for mechanical engineering. After winning local fairs for innovative clock and watch designs, he traveled abroad in the late 1830s and learned of new uses for cast iron as a building material. Bogardus returned to the U.S. determined to construct buildings that would be fireproof, easy to assemble, and strong while still aesthetically pleasing.

His iron buildings permitted bigger windows because less of the surface area of a wall had to be devoted to load-bearing supports. The iron buildings could also be taller than masonry structures because of the strength of the iron frames used by Bogardus. He built an all-iron factory in New York City to produce the buildings, and during the 1850s, he constructed large buildings of iron in most major cities. His more purpose-built structures include fire department observation towers and iron-framed shot towers.

Photo credit: Courtesy of Smithsonian Institution Libraries, Washington, D.C.

Moses G. Farmer

Improvement in Electromagnetic Alarm-Bells

Patent No. 8,920

Born February 9, 1820
Died May 25, 1893

Inducted in 2006

Inventor and manufacturer Moses Farmer pioneered the practical application of electricity, using it to drive numerous inventions, including the first electric fire alarm system and the "self-exciting" dynamo.

Born in Boscawen, New Hampshire, Farmer attended Dartmouth College. After graduating in 1840, he began working on an electric striking apparatus for a fire alarm service with William Channing. The system had a signaling mechanism that triggered a special water motor that drove the electric dynamo. Their alarm system was an immediate success following the system's installation in Boston in 1851, the first electric fire-alarm system in the United States. Farmer's interest led him to invent an incandescent electrical lamp in 1859 with a platinum wire filament supplied by a wet-cell battery. Improving on the design to ensure practicality and application, Farmer conceived and patented the "self-exciting" dynamo. One dynamo lit a private residence with forty incandescent lamps arranged in multiple series.

Farmer continued to expand the capabilities of electricity for the remainder of his life, becoming an electrician at the United States Torpedo Station in Rhode Island in 1868. He later served as a consulting electrician for the United States Electric Lighting Company of New York.

Photo source: Langstroth on the Hive and Honey Bee, 23rd ed., 1927

Lorenzo L. Langstroth

Bee Hive

Patent No. 9,300

Born December 25, 1810
Died October 6, 1895

Inducted in 2007

Lorenzo Langstroth invented the modern beehive in 1851, enabling a greater production of honey. The domesticated honeybee's honey is not just a food and sweetener, but also useful as a topical antibiotic. The honeybees themselves are helpful at pollinating farmers' crops.

Langstroth was born in Philadelphia, Pennsylvania and graduated from Yale College in 1831. As a hobby, he experimented with beekeeping and hives. Prior to Langstroth's work, beekeepers could not monitor the health, production, or containment of bees while harvesting honey. His recognition of "bee space"—the idea that bees will not obstruct passages approximately their size, about one-fourth inch—led him to invent the "Langstroth hive," which contained frames carefully spaced in a box that could be removed and inspected. The hive also allowed the beekeeper to gather honey, attend to the bees, and prevent them from fleeing.

Langstroth's hive revolutionized the art of beekeeping. His design made it easy to inspect hives for disease, monitor the health of colonies, and harvest honey. His hive boosted overall honey production by allowing the bees to fill old combs with new honey. Seventy-five percent of beehives in use today are based on his design.

Photo credit: American Textile History Museum

George Crompton

Loom for Weaving Figured Fabrics

Patent No. 11,933

Born March 23, 1829
Died December 29, 1886

Inducted in 2007

Over his lifetime, George Crompton's inventive prowess revolutionized the textile industry.

Born in Lancashire, England, Crompton moved to the U.S. at the age of ten, learning the trade of building looms while working in his father's loom shops. Upon graduating from school, Crompton worked for the Colt Company, where he became exposed to the insightful manufacturing techniques utilized by Samuel Colt.

Taking over the family business upon his father's death, Crompton immediately set about improving his father's design and was granted his first patent in 1854. His improvements added sixty percent to the operating capacity of the loom and reduced the amount of labor needed to run it by half. He simplified the designs of looms, allowing them to be built less expensively and more quickly. Crompton's simpler looms were easier to maintain and repair, making them more capable of producing greater varieties of weaving than their predecessors. His newer looms could produce patterns and fabrics never seen before, extending fancy textiles to wider audiences.

Crompton's looms were internationally recognized for their technical superiority. He won the top prize at the Paris Exposition, competing against the best looms from Britain, France, Belgium, and other textile-producing countries.

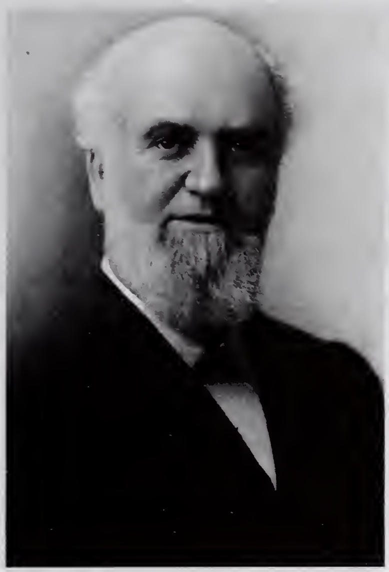


Photo credit: Frontispiece from Lewis Miller: A Biographical Essay, by Ellwood Hendrick. New York, London, G.P. Putnam's sons, 1925

Lewis Miller

Improvement in Mowing Machines

Patent No. 15,160

Born July 24, 1829
Died February 17, 1899

Inducted in 2006

Holder of ninety-two patents, Lewis Miller's most significant invention was the Buckeye Mower and Reaper, the prototype for the modern mower.

Miller was born in Greentown, Ohio. Educated through high school, he joined the farm equipment firm Aultman, Miller & Company at the age of twenty. For the next six years Miller invented and patented the practical horse-drawn Buckeye Mower, advancing McCormick's reaper by adding a floating cutting bar in front of the farmer for safety. The bar's most distinct feature provided the operator the option to raise or lower the cutting bar parallel to the ground. Its versatility enabled the mower to travel through gates and barns and over rocks and other impediments. The Buckeye Mower Machine became instantly popular and Miller's business expanded rapidly. Miller furthered its popularity by making several improvements to the design of the mower and the process for mass production. Miller became head of the company, but also served as superintendent to oversee day-to-day operations.

A philanthropic man, Miller was active in the Akron, Ohio community for most of his life, forming the Sunday school at the Methodist Episcopal Church in 1864. Pursuing his passion for education, Miller co-founded the Chautauqua Institution, in Chautauqua, New York, in 1874.

Photo credit: Picture provided by Hexion Specialty Chemicals, Inc., FKA Borden

Gail Borden, Jr.

Improvement in Concentration of Milk

Patent No. 15,553

Born November 9, 1801
Died January 11, 1874

Inducted in 2006

Gail Borden, Jr.'s process for condensing milk offered the first way to preserve milk without refrigeration, and improved the diet of nineteenth century Americans. Condensed milk helped to change the dairy business from a local farmer-to-consumer business into a major industry.

Borden was born in Norwich, New York. Although he had only a little more than one year of formal schooling, he had a strong desire to find ways to improve daily life. After a series of less successful inventions, Borden witnessed children die aboard a steamship for lack of fresh milk and determined to find a way to keep milk from spoiling.

Anticipating the work of Louis Pasteur, Borden believed that protecting milk from airborne impurities would keep it from spoiling. He used a vacuum pan with a heating coil to vaporize the water from the milk without burning or souring it. Unequaled in purity at the time, the resulting condensed milk could be stored and shipped over long distances. During the Civil War, the Union Army ordered more of the milk than Borden's factory could produce. Word of its advantages quickly spread to the public and the milk industry flourished.

After establishing his condensed milk business, Borden turned to the concentration of other foods, including fruit juices, tea, coffee, and cocoa.

Photo credit: From the Historical and Interpretive Collection of The Franklin Institute, Inc., Philadelphia, PA

William Sellers

Improvement in Boring-Mills

Patent No. 17,641

Born September 19, 1824
Died January 24, 1905

Inducted in 2007

William Sellers built machines that helped facilitate the American Industrial Revolution.

Born in Upper Darby, Pennsylvania, Sellers received a private-school education before apprenticing to become a machinist. After his apprenticeship, Sellers headed a machine shop in Rhode Island, which he left after three years to establish a shop in Philadelphia, making machine tools and heavy equipment.

Sellers invented new machine tools, such as the spiral-geared planer, a bolt-making machine, and various gear-cutting machines. He also made older designs with greater precision, allowing the machine tools in turn to create more precise and standardized products. He streamlined his designs for machine tools, eliminating the ornamentation that had distinguished antebellum designs, and reinforced them, making them capable of performing heavier work.

Sellers also played key roles on the boards of organizations such as the Franklin Institute, the University of Pennsylvania, the National Academy of Sciences, and engineering societies in America and Europe. He was well known for his 1864 address to the Franklin Institute proposing an American standard screw thread. Sellers' design eventually became the American standard and was a significant contributing factor to the development of interchangeable parts.

Photo credit: Courtesy of Library of Congress, Prints & Photographs Division, LC-USZ62-99852

Henry Bessemer

Manufacture of Iron and Steel

Patent No. 16,082

Born January 19, 1813
Died March 15, 1898

Inducted in 2002

British inventor Henry Bessemer's creation of the Bessemer converter was a major advancement for steel making. Prior to his work, steel was scarce, made through a costly and arduous process. His technique prompted a revolution in manufacturing.

Bessemer's interest in steel came from an idea he had during the Crimean War to make a new type of artillery. Existing cannons were not strong enough, so he thought to improve the cannons by strengthening the steel. In doing so, he created the idea for the Bessemer converter, which allowed unskilled workers to make vast quantities of quality steel cheaply. An egg-shaped vat held molten iron, and cold air was blown into perforations in the bottom to remove the carbon and other impurities in the iron. The process only took 20 minutes and raised annual steel production enormously while reducing cost dramatically. Vital in propelling the Industrial Revolution, the Bessemer converter ceased being used in the mid-1900s.

Born in Hertfordshire, England, Bessemer received 110 patents throughout his life. His inventions included a solar furnace, a way to make graphite for pencils, an astronomical telescope, and a diamond-polishing machine. He eventually became a millionaire from his many patented works.

Photo credit: Whitney Library, The New Haven Museum & Historical Society

Eli Whitney Blake

Machine for Crushing Stone

Patent No. 20,542

Born January 26, 1795
Died August 18, 1886

Inducted in 2007

Eli Whitney Blake developed machinery used for crushing stone, creating a more efficient method for road construction.

During Blake's tenure on a committee to build a stretch of road near New Haven, Connecticut, he observed that crushing rock necessary for road construction relied on an individual breaking stone with a hammer. Inspired by this realization, Blake spent the next years of his life designing a machine that could crush rocks to the desired size.

Blake's machine consisted of a pair of jaws—comprised of a stationary and movable jaw—that delivered the crushing mechanism. This enabled the crusher's operator simply to feed stones into the machine and the closing action of the jaws would crush stone to the desired size. Blake formed the Blake Rock Crusher Company to produce his device and over 500 machines were in use by 1879. The inventor himself estimated that the crusher, by that time, had saved its users upwards of $55 million. Still in use today, the Blake rock crusher has played an instrumental role in road construction.

Born in Westborough, Massachusetts, Blake graduated from Yale College. His interests also extended into the realm of theoretical science, and he contributed to the field of mechanics and fluid dynamics.

Photo credit: Courtesy of the Library of Congress

John L. Mason

Improvement in Screw-Neck Bottles

Patent No. 22,186

Born 1832
Died February 26, 1902

Inducted in 2006

John Mason invented and patented the first glass jar with a screw-on cap in 1858.

From early human history, farmers searched for a method to keep food from spoiling. Prior to canning, foods were dried, smoked and salted, or soaked in sugar for preservation. Other methods of canning preceded Mason's, but did not provide long-term food preservation and were extremely cumbersome. Mason, a tinsmith, developed a square-shouldered jar that provided an airtight seal. The jar had a threaded neck and a threaded metal cap that screwed down over a rubber seal to the jar's shoulder, creating an airtight seal. The jars offered a more reliable method of preserving foods and were an immediate success. With the increased safety and convenience of canning, urban populations were able to take advantage of fresh produce. The jars were affordable and re-useable and allowed for preservation of garden or farm produce such as tomatoes, pickles, fruits, and relish for use in the winter.

Mason jars were an integral part of food preservation for the next 100 years. Although canning decreased in popularity as refrigeration and other forms of food preservation emerged, the Mason jar is still today the common term for the fruit jar and is used in home canning.

Photo credit: Otis Elevator Company Historic Archives

Elisha Graves Otis

Improvement in Hoisting Apparatus

Patent No. 31,128

Born August 3, 1811
Died April 8, 1861

Inducted in 1988

Elisha Graves Otis didn't invent the elevator; he invented something perhaps more important—the elevator brake—which made skyscrapers a practical reality. Born near Halifax, Vermont, Otis made several failed attempts at establishing businesses in his early years. Finally, in 1845, he tried to change his luck with a move to Albany, New York. There he worked as a master mechanic in a bedstead factory. He remained about three years and during that time invented a railway safety brake, and ingenious devices to run rails for four-poster beds and to improve the operation of turbine wheels.

By 1852 he had moved to Yonkers, New York, to organize and install machinery for the bedstead firm of Maize & Burns, which was expanding. Josiah Maize needed a hoist to lift heavy equipment to the upper floor, but traditional hoists had inherent safety problems. Otis created a superior device, a tough, steel wagon-spring meshing with a ratchet, and so created the elevator brake.

In 1854, Otis dramatized his safety device on the floor of the Crystal Palace Exposition in New York. The inventor ascended in an elevator inside an open-sided shaft. Halfway up, he had the hoisting cable cut with an axe. The platform held fast, and the elevator industry was on its way.

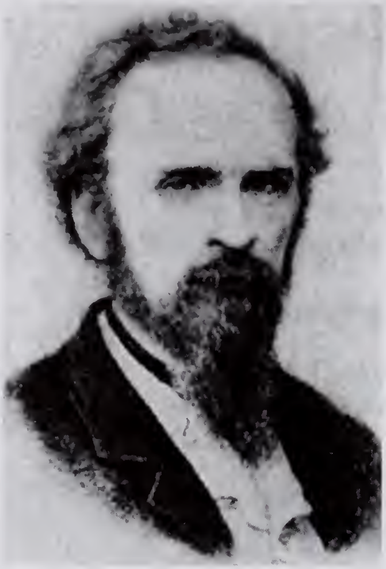


Photo credit: Courtesy of Yale Residential Security Products, Inc.
2725B Northwoods Parkway, Norcross, GA 30071 www.yalelock.com
"Fine locks since mid-19th century."

Linus Yale, Jr.

Post-Office Drawer Lock

Patent No. 31,278

Born April 4, 1821
Died December 25, 1868

Inducted in 2006

Linus Yale, Jr. made radical innovations in lock making that were the basis for the modern key and tumbler lock.

Yale was born in Salisbury, New York. Well-educated and having an early interest in art, he worked as a portraitist for several years before following his father into the lock making business.

Yale initially focused on improving bank safe locks. He patented an "unpickable" lock, called the "Yale Infallible Bank Lock," in 1855. A number of improved key-based bank locks followed. Yale then developed the first combination lock, eliminating the need for a key. Next, the inventor turned his attention to general-use locks. He improved on his father's design for small key and tumbler locks, and invented the first modern cylinder lock. Based on a pin-tumbler mechanism known to the ancient Egyptians, Yale devised a lock that used a smaller, flat key with serrated edges like those still in use today. His device became widely known as the "Yale lock."

In 1868, Yale and Henry R. Towne together established the company that became the Yale Lock Manufacturing Company. By the early twentieth century, the company employed more than 12,000 people worldwide. Yale locks are still widely used in both commercial and general applications.

Photo credit: Courtesy of the Library of Congress

George M. Pullman

Improvement in Sleeping Cars

Patent No. 42,182

Born March 3, 1831
Died October 19, 1897

Inducted in 2006

George Pullman improved the comfort of rail travel at a time when it was America's most important form of transportation. The traveling public, weary of cramped and uncomfortable sleeping accommodations, was so enthusiastic about the Pullman car that railroads made structural changes to bridges and platforms to accommodate its size.

Pullman was born in Brocton, New York. Schooled until age fourteen, he learned cabinet making, moved buildings, and ran successful business ventures in gold-rush Colorado before returning east, to Chicago, in 1863. There, he set about designing an improved sleeping car.

In July 1863, Pullman and his business partner Benjamin Field delivered *Pioneer*, a 56-passenger sleeping car with an interior that resembled a parlor by day and a first-class hotel room at night. Hinged upper berths folded out of the car's ceiling, and facing seats slid away from the walls to form the lower berths. Pullman formed the Pullman Palace Car Company in 1867 to build and operate the cars.

Pullman also patented a dining car and a hotel car with individual rooms, and built a planned community for Pullman workers with private homes, schools, a church, a library, and a hotel. A Pullman car carried the body of President Abraham Lincoln to Illinois after his assassination in 1865.

Photo credit: Joseph Saxton, courtesy of the American Philosophical Society

Joseph Saxton

Improvement in Hydrometers

Patent No. 44,460

Born March 22, 1799
Died October 26, 1873

Inducted in 2006

Despite having had no formal scientific training, Joseph Saxton invented important measuring devices, including a hydrometer to measure the specific gravity of fluids.

Born in Huntingdon, Pennsylvania and apprenticed to a watchmaker at age twelve, Saxton made the belfry clock for Independence Hall in Philadelphia before he was thirty. He spent almost a decade constructing scientific apparatus at the Adelaide Gallery of Practical Science in London, before returning to Philadelphia as Curator, Standard Weighing Machinery for the United States Mint. There, he designed the balances used to verify standard weights in government offices. In 1843, he became superintendent of weights and measures for the United States Coast Survey, a position he retained for the rest of his life.

Saxton made many technological innovations during his career. These included a reflecting pyrometer used in the first comprehensive survey of the United States coastline, and the first known dynamo. In 1854, he invented a self-registering tide gauge that is believed to have been the first gauge to record an earthquake.

Saxton was one of the fifty charter members of the National Academy of Sciences. He was awarded the Franklin Institute's John Scott Legacy Medal for his reflecting pyrometer.

Photo credit: Deere & Company

John Deere

Improvement in Plows

Patent No. 46,454

Born February 7, 1804
Died May 17, 1886

Inducted in 1989

John Deere developed the first American cast steel plow. Born in Rutland, Vermont, Deere served a four-year apprenticeship to a blacksmith and worked in that trade until 1837, when he moved to Grand Detour, Illinois.

The implements being used by pioneer farmers of that day were cumbersome and ineffective for cutting and turning the prairie soil. To alleviate the problem, Deere and a partner, Major Leonard Andrus, designed three new plows in 1838. Their cutting part was made from steel cut from an old sawmill blade and shaped by bending it over a log. The moldboard, used for lifting and turning, was made of wrought iron and polished on the upper surface to prevent clogging.

The plow was so successful that by 1846, Deere and his partner were selling a thousand a year. Deere then sold his interest in the Grand Detour enterprise to Andrus and organized a plow company in Moline, Illinois. After experimenting with imported English steel, he had a cast steel plow made for him in Pittsburgh. By 1855 he was selling more than 13,000 such plows a year. In 1868 his business was incorporated as Deere & Company, which is still in existence today.

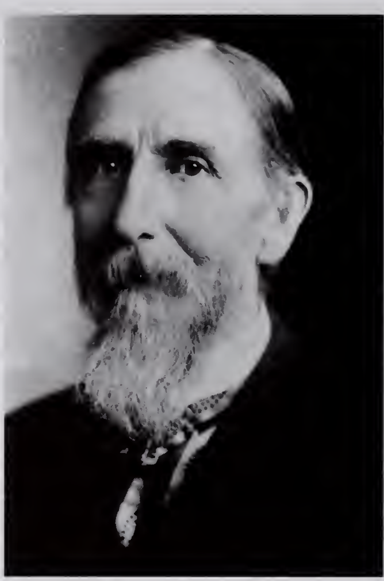


Photo credit: *Courtesy of Hasbro, Inc. ©2006*
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Milton Bradley

Social Game

Patent No. 53,561

Born November 8, 1836
Died May 30, 1911

Inducted in 2006

Milton Bradley, inventor of the *Checkered Game of Life,* ushered in a new age of parlor games.

Born in Vienna, Maine, Bradley worked as a mechanical draftsman and patent agent, but became interested in lithography. He opened his own business – the Milton Bradley Company – in Springfield, Massachusetts, in 1860.

With the Civil War dominating America, Bradley wanted to create games to counteract the dour national mood. He conceived a game that could provide both factual instruction and moral advice to young people. He developed the *Checkered Game of Life,* which included a top that spun to indicate the number of squares for a player to advance. Bradley sold 40,000 copies of the game in the first year. *The Game of Life* is still popular today.

Bradley invented other games, including *The Smashed-Up Locomotive, Croquet Bridge,* and mechanical puzzles. Additionally, he printed manuals for games, and the rules he established are still used today.

The Milton Bradley Company prospered until the late 20th century. In 1984, Hasbro, Inc. acquired the company and its subsidiary, Playskool, Inc. Hasbro is now the largest game and puzzle maker in the world.

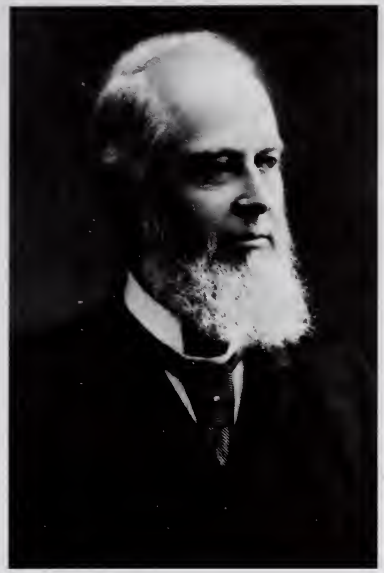


Photo credit: The Babcock & Wilcox Company

George H. Babcock

Improvement in Steam Generators

Patent No. 65,042

Born June 17, 1832
Died December 16, 1893

Inducted in 1997

George H. Babcock and Stephen Wilcox invented an improved water tube steam boiler, which provided a safer and more efficient production of steam. Born in Unadilla Forks, New York, Babcock was part of a family of inventors and mechanics.

In 1860, after moving to Brooklyn, he attended evening classes at Cooper Institute. During the American Civil War, he worked for the Mystic (Connecticut) Iron Works building ships for the U.S. government. He became chief draftsman at the Hope Iron Works in Providence, Rhode Island, where he joined Stephen Wilcox in improving boiler designs.

The two men received their patent in 1867 and formed a partnership that same year. In 1881, the company was incorporated with Babcock as president and Wilcox as vice president. Since then, Babcock & Wilcox has become a world leader in the power generation industry and is a major operating unit of McDermott International, a worldwide energy services company.

Photo credit: The Babcock & Wilcox Company

Stephen Wilcox, Jr.

Improvement in Steam Generators

Patent No. 65,042

Born February 12, 1830
Died November 27, 1893

Inducted in 1997

Stephen Wilcox worked with George Babcock to invent the water tube steam boiler. This boiler allowed safer and more efficient production of steam. Wilcox, who was born in Westerly, Rhode Island, began inventing at a young age and eventually, turned his attention to steam boilers. In 1856, he created a safety water tube boiler with inclined tubes.

It was the forerunner of the model he and Babcock patented in 1867. With their new patent in hand, the two men established a partnership which later became the Babcock & Wilcox Company. The firm's boilers soon paved the way for the development of high pressure, high temperature power plants for electricity production. Babcock & Wilcox boilers were also used to power U.S. Navy and Merchant Marine ships, beginning a relationship that continues today.

Currently, Babcock & Wilcox is a leader in its industry, designing, supplying, and servicing power generation systems and equipment worldwide.

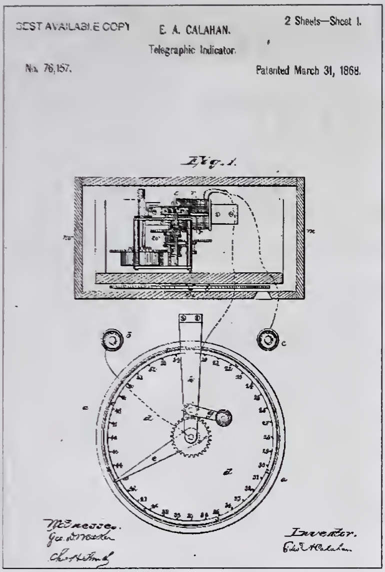


Image of patent no. 76,157 courtesy of the United States Patent and Trademark Office

Edward A. Calahan

Improvement in Telegraphic Indicators

Patent No. 76,157

Born 1838
Died 1912

Inducted in 2006

Edward Calahan invented the stock ticker in 1863, enabling quotes for stocks, bonds, and commodities to be transmitted directly from exchange floors to brokers and investors across the country. The New York Stock Exchange (NYSE) was one of the first to use the new device.

Calahan was born in Boston, Massachusetts. Wanting to be part of a modern business, he left school at age eleven and became a telegrapher for the firm that later became the Western Union Company. While he was working as chief telegrapher in Western Union's New York office, a chance encounter with a group of rushing messenger boys near one of New York's many exchanges inspired him to improve exchange communications. Before Calahan's invention, messengers ran price updates from exchange floors to brokers' offices. With the stock ticker, exchanges could telegraphically transmit the name and price of every stock sold. Broader communications capabilities allowed the NYSE to centralize order flow and improve liquidity, spurring its growth and consolidating business that had been scattered among many local exchanges.

Calahan, working with George B. Field, also invented the pneumatic telegraph system, the first telecommunications system that allowed communication from a central station to multiple points within a district.

Photo credit: Archive Center, National Museum of American History, Smithsonian Institution

Charles G. Page

Improvement in Induction-Coil Apparatus and in Circuit-Breakers

Patent No. 76,654

Born January 25, 1812
Died May 5, 1868

Inducted in 2006

Charles Grafton Page invented the first high-voltage induction coil in 1836. The high-voltage induction coil became an important tool of scientific research, and a standard component of automobile ignition systems in the twentieth century.

Page was born in Salem, Massachusetts. He graduated from Harvard Medical School in 1836 and, after residency at Massachusetts General Hospital, set up his own medical practice. Although trained as a physician, he was fascinated by the science of electricity. He designed an electrostatic machine at age ten and published the first of over forty papers on electromagnetic devices by the time he was twenty-two. An improvement upon Joseph Henry's calorimeter, Page's device produced a higher intensity spark, and thus higher voltage than earlier induction coils. The basic principals of his design are still used in induction coils today.

Page invented a number of other electrical devices, including a self-acting circuit breaker and a small reciprocating electro-magnetic engine. Having left the medical field, he worked as a patent examiner from 1841 to 1852 and from 1861 until his death. During that period, he also served as a professor at Columbian College (George Washington University) and co-editor of the *American Polytechnic Journal.*

Photo credit: ©The Nobel Foundation

Alfred Nobel

Improved Explosive Compound

Patent No. 78,317

Born October 21, 1833
Died December 10, 1896

Inducted in 1998

Alfred Nobel, the inventor of dynamite, was also a great industrialist. Born in Stockholm, Sweden, Nobel moved with his family as a youngster to St. Petersburg where he was tutored privately by leading university professors. After the Crimean War, the family returned to Sweden. In 1863, Nobel developed the Nobel patent detonator, which detonated nitroglycerin using a strong shock rather than heat. In 1865, the Nobel Company built the first factory for producing nitroglycerin. This led to the establishment of many factories around the world.

Nitroglycerin in its fluid state is very volatile. Nobel recognized this, and eventually patented dynamite, a combination of nitroglycerin absorbed by a porous substance. This gave him an easily handled, solid yet malleable explosive. This made nitroglycerin a useful explosive. Mining, railroad building, and other construction became safer, more efficient, and cheaper.

Nobel developed many improvements in explosives, and he held 355 patents in different countries in electrochemistry, optics, biology, and physiology. Upon his death, his will provided that the bulk of his fortune go to a fund that would award prizes annually for advancements in Physics, Chemistry, Physiology or Medicine, Literature, and Peace.

Photo credit: State Historical Society of Wisconsin, WHi (x313) 2564

Christopher Sholes

Type Writing Machine

Patent No. 79,265

Born February 14, 1819
Died February 17, 1890

Inducted in 2001

Christopher Sholes invented the first practical typewriter and introduced the keyboard layout that is familiar today. As he experimented early on with different versions, Sholes realized that the levers in the type basket would jam when he arranged the keys in alphabetical order. He rearranged the keyboard to prevent levers from jamming when frequently used keys were utilized. The rearranged keys in the upper row formed the order QWERTY, and the design exists to this day.

Sholes was born in Danville, Pennsylvania. As a young teenager, he apprenticed with a printer. Shortly after, he moved to Wisconsin where he worked as a printer, editor, and journalist. Always interested in issues of the day, Sholes served two terms as a Wisconsin senator, another term in the state assembly, and helped found the Republican Party in Wisconsin. Eventually, President Lincoln asked Sholes to become customs collector for the port of Milwaukee.

Sholes enlisted the help of investors to sell his typewriter, but his marketing tactics were not successful. In 1873, he sold his rights to the Remington Arms Company. The company began manufacturing the Remington typewriter, and Sholes continued to devise improvements for it. In 1878, he added a shift key to give users the option of lowercase or uppercase letters.

Photo credit: Courtesy of the American Society of Chemical Engineers

Alexander L. Holley

Improvement in the Manufacture of Iron and Steel by the Bessemer or Pneumatic Process

Patent No. 86,303

Born July 20, 1832
Died January 29, 1882

Inducted in 2006

Alexander Holley was responsible for important technological developments in the American steel industry during the nineteenth century.

Born in Lakeville, Connecticut, Holley received his first patent for a steam engine cutoff while still in college. After graduating from Brown University in 1853, while on a trip to investigate armor making, Holley discovered Henry Bessemer's steelmaking process.

After Holley bought the American rights to Bessemer's patent, he set up a steelworks at Troy, New York, in 1865. There, he developed the most important improvement to Bessemer's process – the "Holley bottom," a removable section at the base of Holley's Bessemer converters. Due to the extreme heat of the steelmaking process, the brick bottoms of the converters would break down quickly and have to be replaced. A traditional Bessemer converter had to cool down before workers could fix it, taking additional time and fuel to reheat the converter. Holley's swappable converter bottom allowed replacement without cooling the entire converter, increasing productivity over the traditional design.

Holley also contributed to the industry's development through his active participation in professional societies such as the American Society for Mechanical Engineers, which he helped found.

Photo credit: Courtesy of the Portland Historical Society – Portland, Connecticut

Thomas R. Pickering

Improved Velocipede

Patent No. 88,507

Born 1831
Died February 21, 1895

Inducted in 2007

Thomas Pickering's inventive genius allowed him to make significant engineering advancements. He is most known for his contributions to the steam-engine governor and velocipede.

A native of England, Pickering moved to New York City as a boy. He studied at the Mechanics' Institute to learn the basics of engineering. In 1861, he was in charge of the steam power plant at a factory when he developed a steam governor that quickly replaced its predecessors because it enabled far better control of steam engines and their power input.

He continued to innovate and encourage the professional development of engineering in the United States. In 1868, Pickering invented the velocipede, which was a forerunner to the modern bicycle, and sold large numbers of the machines. The velocipede's success in the U.S. and Europe was due to a self-absorbing brake. Pickering's brake was a novel design that pressed a brake shoe against the wheel rim when the rider pressed levers on the handlebars.

He was a member of the ASME, served as a commissioner at the 1876 Centennial exposition and the 1884 New Orleans exposition, and represented the United States engineering community at international expositions in Vienna, Melbourne, and Paris. He was elected a U.S. Senator in 1894 and died while in office.

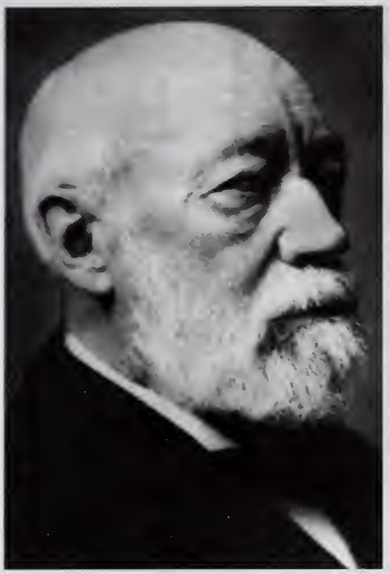


Photo credit: Courtesy of the National Plastics Center

John Wesley Hyatt

Improved Molding Composition to Imitate Ivory and Other Substances

Patent No. 88,633

Born November 28, 1837
Died May 10, 1920

Inducted in 2006

John Hyatt invented the process for making celluloid, the first artificial plastic.

In the late 1860s, while searching for a substitute for ivory for making billiard balls, Hyatt combined nitrocellulose, camphor, and alcohol and heated the mixture under pressure to make it pliable for molding. In addition to creating this new material, he developed the necessary machinery for working it. One of the first uses of the new plastic material was for making denture plates.

In the late 1880s, celluloids were developed for photographic film, laying the groundwork for photographic film to replace the photographic plate. As a thermoplastic, celluloid had a wide variety of uses in the nineteenth century and the first half of the twentieth century, and as a result had a significant economic impact during this time. Items such as knife handles, ballpoint pen bodies, collars and cuffs, and toys were made of celluloid.

Born in Starkey, New York, Hyatt also invented the Hyatt filter, which effectively purified water while in motion. Hyatt continued inventing later in his life, developing a widely-used type of roller bearing, a sugarcane mill superior to any previously used, and a sewing machine for making machine belting.

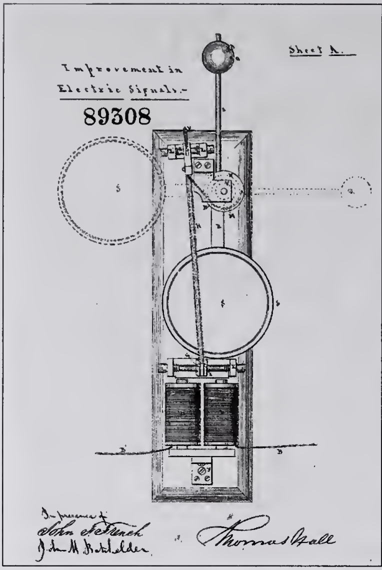


Image of patent no. 89,308 courtesy of the United States Patent and Trademark Office

Thomas Seavey Hall

Improvement in Electric Signals for Railroads

Patent No. 89,308

Born April 1, 1827
Died December 1, 1880

Inducted in 2007

The 1860s and 1870s were pivotal decades for improving safety in the railroad industry. Many of these innovations were invented by Thomas Seavey Hall.

Born in Upper Bartlett, New Hampshire, Hall attended Middlebury College. In 1886, he witnessed a train accident that occurred from a misplaced switch. In response, Hall set out to invent improved signals that would better alert train engineers to the presence of oncoming trains, as well as alerting travelers crossing railroad intersections. His first patent was designed to alert employees of station homes to an improperly placed switch. The system was designed to produce an alarm that would sound continuously in case a switch was not properly placed.

In 1869, Hall was issued a patent for a banjo signal that would become essential to railroad safety. Unlike his earlier patent, the banjo switch was designed to alert a train engineer of the presence of another train on a stretch of track by using electromagnetism to display a sign shaped like a banjo. While the concept of the banjo signal was successful, it tended to malfunction in inclement weather. This precipitated Hall to redesign his signal, encasing it in a watertight enclosure to ensure proper functioning in ice and snow.

Photo credit: Image courtesy of Department of History, University of Rochester

Birdsill Holly, Jr.

Improvement in Systems of Water-Supplies for Cities

Patent No. 94,746

Born November 8, 1820
Died April 27, 1894

Inducted in 2006

Birdsill Holly invented a system to supply water to cities without reservoirs or standpipes, and to extinguish fires through a system of hydrants that eliminated the need to equip fire engines with water tanks.

Holly was born in Auburn, New York, where his common school education ended at age eight. He was apprenticed to a cabinetmaker, and later to a machine shop owner. He became a shop superintendent in his late teens, and was granted the first of many patents before he was thirty. In 1859, he founded the Holly Manufacturing Company in Lockport, New York.

Seeing the destruction serious fires had caused in Lockport, Holly devised a pumping system that provided water through underground mains to pipes and hydrants throughout the city. The pumps were situated near a water supply and could be powered by water or steam. Over two thousand cities that adopted Holly's system enjoyed a constant supply of water and improved fire protection at relatively low cost.

Holly also invented a district steam-heating system in 1877. That system replaced many individual boilers with a large central plant that furnished steam to several buildings in a surrounding district. By the end of the century, a number of district heating companies had been formed, principally in large cities.

Photo credit: California Historical Society FN-25322

Andrew Smith Hallidie

Improvement in Grip Pulleys

Patent No. 100,140

Born March 16, 1836
Died April 24, 1900

Inducted in 2006

Andrew Hallidie left his mark on San Francisco as the inventor of the first cable railway, which enabled the widespread use of cable cars throughout the city.

Born in London, England, Hallidie was schooled in engineering and received practical training in surveying. At the age of 17, he moved to California and eventually worked as a contractor and surveyor.

Hallidie built a solid reputation designing wire suspension bridges and flumes for use in mines along the Pacific coast and into British Columbia. In 1857, he became involved in manufacturing wire rope and soon began concentrating on the concept of transporting freight by means of endless wire rope. The success of the "Hallidie ropeway" for use in mines caused Hallidie to think of alternatives for transporting people on the steep streets of San Francisco.

Hallidie's idea was based on the principle of an endless wire rope that was in continuous motion underground. The car could be attached and released from the cable by a hook. When Hallidie first presented the idea of a cable car to the public he was ridiculed. Undaunted, with the help of friends and investors, Hallidie raised the capital to experiment with a single line on one street. The experiment proved to be successful, and cable cars became popular not only in San Francisco, but in other cities as well.

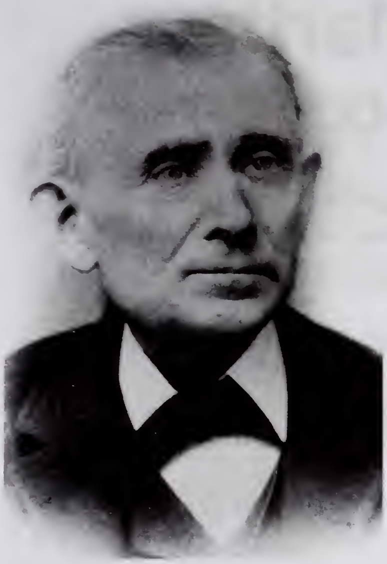


Photo credit: Courtesy of Ingersoll Rand Company Limited

Simon Ingersoll

Improvement in Rock-Drills

Patent No. 112,254

Born March 3, 1818
Died July 24, 1894

Inducted in 2006

Simon Ingersoll's practical powered drill played an important role in construction and excavation for more than a century. Percussion drills derived from Ingersoll's design have been used in excavation, mining, tunneling, and highway construction.

Born in Stanwich, Connecticut, Ingersoll received an informal grade school education. He received his first patent in 1858 for a steam engine shaft. He developed other inventions over the next ten years, including a scale, a friction clutch, and a latch for gates.

By 1870, Ingersoll had invented a drill that replaced hand drilling, making mining and tunneling much faster and cheaper. Before Ingersoll's drills, underground drilling was done by striking a length of steel rod repeatedly with a sledgehammer. Ingersoll's drill surpassed earlier drills because it rotated the drill after each strike, automatically advancing the steel. Ingersoll's design also featured an innovative tripod, and was significantly lighter than other drills. His first design was powered by steam but later operated on compressed air.

The Ingersoll rock drill was the basis for the Ingersoll Rand Corporation. Although Ingersoll Rand no longer manufactures drills, its products range from biometric security readers to refrigeration technologies.

Photo credit: *General Research Division, The New York Public Library, Astor, Lenox and Tilden Foundations*

Martha Coston

Improvement in Pyrotechnic Night-Signals

Patent No. 115,935

Born December 12, 1826
Died July 9, 1904

Inducted in 2006

Following rough sketches left by her late husband, a naval scientist, Martha Coston developed a system of pyrotechnic flares that she sold to the United States Navy. The system of night communication gave the Union a decided advantage in the Civil War, and the company Coston founded for production of the flares remained in business until the late twentieth century.

Coston spent ten years testing and refining her process of night flares before patenting it in 1859. The Coston signal flare used bright and long-lasting flares in red, white, and green for ship-to-ship or ship-to-land signaling over great distances. During the Civil War, the Coston Manufacturing Company sold the signals at cost to the Navy, but Coston struggled for decades to receive compensation for the supplies.

The Coston signal flare and code system was used by the United States Life Saving Service (the forerunner of the United States Coast Guard), the U.S. Weather Service, military institutions in England, France, Holland, Italy, Austria, Denmark, and Brazil, commercial merchant vessels, and private yachting clubs.

Coston was born in Baltimore, Maryland. Receiving no formal education, she was an independent inventor and successful entrepreneur at Coston Manufacturing Company.

Photo credit: AIP Emilio Segrè Visual Archives, Brittle Books Collection

Zénobe Théophile Gramme

Improvement in Magneto-Electric Machines

Patent No. 120,057

Born April 4, 1826
Died January 20, 1901

Inducted in 2006

Zénobe Théophile Gramme invented the first successful direct-current (DC) dynamo. His dynamo, or generator, produced much higher voltages than earlier designs and was the first electric generator to be used commercially.

Born in Belgium, Gramme left school at an early age, semi-literate and knowing only simple arithmetic. Nonetheless, he became interested in electrical devices while working in Paris as a model maker for a company that manufactured electrical equipment. There, he improved the alternating current (AC) dynamo before creating his DC device.

For his DC dynamo, Gramme replaced the toothed-ring armature of earlier designs with a uniform ring-wound armature that came to be known as the "Gramme ring." His DC dynamo attracted great attention at the 1876 Centennial Exhibition in Philadelphia, and quickly became a commercial success. In 1871, with his associate Hippolyte Fontaine, Gramme opened a factory that manufactured electrical devices and set the standards for the industry.

Gramme's dynamo was used commercially for both electroplating and electric lighting. At the Vienna Exhibition in Austria in 1873, Gramme showed that when run in reverse his dynamo also functioned as an electric motor.

Photo credit: Burton Historical Collection, Detroit Public Library

Elijah McCoy

Improvement in Lubricators for Steam-Engines

Patent No. 129,843

Born May 2, 1844
Died October 10, 1929

Inducted in 2001

Elijah McCoy received his first patent for an automatic lubricating device in 1872. Previously, engines had to be stopped before necessary lubrication could be applied. McCoy's invention allowed engines to be lubricated while they ran, saving precious time and money.

McCoy's parents were slaves who escaped from Kentucky to Canada. McCoy was born in Canada, later moving with his family to Ypsilanti, Michigan. When he was fifteen, his parents sent him to school in Scotland. There, he studied mechanical engineering, a field that had interested him from the time he was young.

Returning home, McCoy was unable to find work as a mechanical engineer, so he went to work for the Michigan Central Railroad as a fireman. His duties included lubricating engine parts. Engines needed frequent lubrication, and each time, the trains had to be stopped and started, an inefficient process. McCoy was convinced there was a better way and invented his automatic lubricator.

McCoy continued to create improvements on his device, and soon, long distance locomotives, transatlantic ships, and factory machines were using his lubricating invention. His reputation spread, and users of heavy equipment were wary of buying cheap substitutes. As a result, they often asked for "the real McCoy," a phrase that still exists in today's vocabulary.

Photo credit: Corbis-Bettmann

Louis Pasteur

Improvement in Brewing Beer and Ale

Patent No. 135,245

Born December 27, 1822
Died September 28, 1895

Inducted in 1978

French chemist Louis Pasteur was the founder of microbiological sciences. Born in Dôle, France, Pasteur received his scientific education at the Ecole Normale Superieure in Paris. He served successfully as professor of chemistry in Strasbourg and professor of chemistry and dean of the Lille Faculty of Sciences, which he organized in 1854. Three years later he returned to the Ecole Normale as director of scientific studies, a post he retained until 1867, when he became professor of chemistry at the Sorbonne.

Pasteur's studies of fermentation began in Lille when he was approached by an industrialist disturbed because undesirable products often appeared during the fermentation of sugar into alcohol by yeast. Pasteur postulated that these products came from microscopic organisms other than yeast and suggested that each type of fermentation was the effect of a specific microorganism, called the germ. He illustrated this revolutionary theory with brilliant studies on the conversion of sugar. Pasteur studied the origin of microorganisms and demonstrated that spontaneous generation does not occur. Spoilage of perishable products could be prevented by destroying the microbes already present in these products and by protecting the sterilized material against subsequent contamination.

Pasteur applied this theory to the preservation of beverages and foodstuffs, introducing the technique of heat treatment now known as pasteurization.

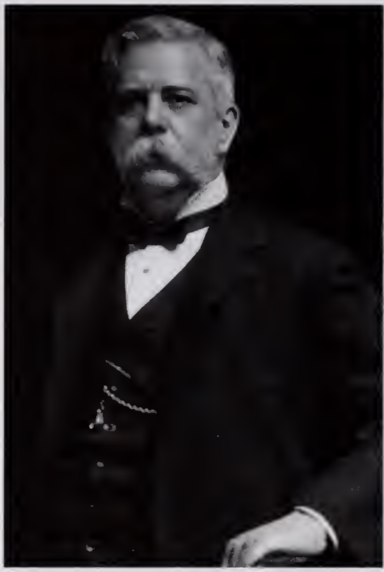


Photo credit: Westinghouse Electric Company

George Westinghouse, Jr.

Improvement in Steam-Power Brake Devices

Patent No. RE. 5,504

Born October 6, 1846
Died March 12, 1914

Inducted in 1989

George Westinghouse, Jr. invented a system of air brakes that made travel by train safe and built one of the greatest electric manufacturing organizations in the United States.

Born in Central Bridge, New York, Westinghouse briefly attended Union College, and then developed and patented a rotary steam engine and a device for replacing derailed freight cars. He then worked on a system of railroad brakes that would centralize control in the hands of the engineer. He was awarded the first of many air brake patents in 1869 and at 22, organized the Westinghouse Air Brake Company; in 1882 he organized the Union Switch and Signal Company. In 1886 he founded the Westinghouse Electric Company, foreseeing the possibilities of alternating current as opposed to direct current.

Westinghouse enlisted the services of Nikola Tesla and others in developing alternating current motors and apparatus for the transmission of high-tension current. His company became the outstanding competitor of General Electric, which in 1896 arranged to use his patents by a cross-licensing agreement. By the turn of the century, the various Westinghouse enterprises employed more than 50,000 workers.

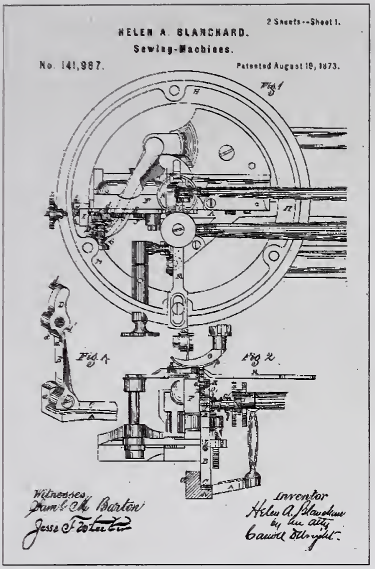


Image of patent no. 141,987 courtesy of the United States Patent and Trademark Office

Helen Blanchard

Improvement in Sewing-Machines

Patent No. 141,987

Born August 25, 1840
Died January 12, 1922

Inducted in 2006

Helen Blanchard's improvements to the sewing machine allowed for the industrial growth of sewing machines. Twenty-two of Blanchard's twenty-eight patented inventions were installed in large factories, saving time and money in the commercial sewing industry.

Born in Portland, Maine, Blanchard showed an aptitude for mechanical devices at an early age. She did not begin patenting her inventions until her family ran into financial difficulties. After business losses from the panic of 1866 and the death of her father, Blanchard and her family had to sell their property. She borrowed money to pay for her first patent.

Blanchard is best known as the inventor of the zig-zag stitch sewing machine, which she patented in 1873. The zig-zag stitch seals the edges of a seam, making a garment sturdier. Blanchard continued to make incremental improvements in both sewing machines and needles, and in 1881 she established the Blanchard Over-Seam Company of Philadelphia. Her company was profitable, and Blanchard was eventually able to buy back her family's lost property.

Although most of Blanchard's patents relate to sewing, she experimented with other ideas, including a patented design for a pencil sharpener.

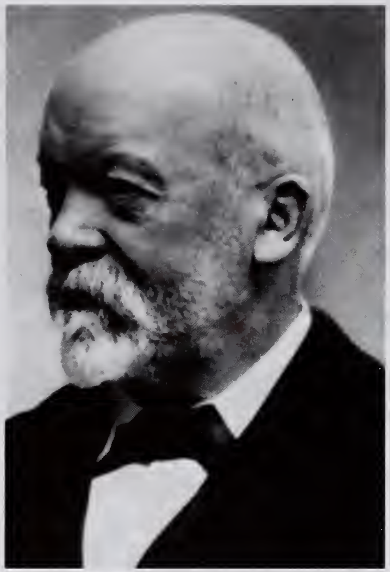


Photo credit: Print Collection, Miriam and Ira D. Wallach Division of Art, Prints and Photographs, The New York Public Library, Astor, Lenox and Tilden Foundations

Gottlieb Daimler

Improvement in Gas-Motor Engines

Patent No. 153,245

Born March 17, 1834
Died March 6, 1900

Inducted in 2006

In 1885, Gottlieb Daimler, with the help of Wilhelm Maybach, developed the forerunner of the modern gas engine by advancing Nicolaus Otto's oil-powered design. Adapting the engine to a stagecoach, Daimler successfully designed the world's first four-wheeled automobile.

After earning a mechanical engineering degree from Stuttgart Polytechnic, Daimler pursued the need for a small, practical, low-powered engine. Frenchman Etienne Lenoir had designed an early model of a smaller engine, but it lacked efficiency. Noting Lenoir's pioneering concepts, Daimler and Maybach spent ten years developing a practical gasoline-powered engine. With their new engine as the focal point, they applied their ideas to vehicles, developing and patenting a self-firing ignition starter. In 1885, the first gasoline-powered internal combustion engine was fitted onto a motorcycle.

Daimler and Maybach continued to improve gasoline-powered engines, inventing the first V-shaped, two-cylinder, four-stroke engine. That engine was the foundation for today's automobile engines. Daimler founded the Daimler Motoren-Gesellschaft in 1890 to build engines according to his designs.

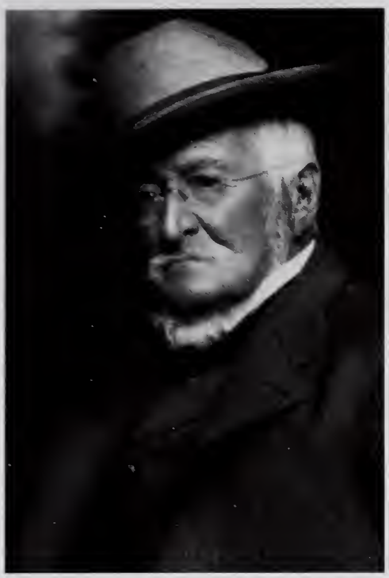


Photo credit: Collection of Ellwood House Museum, DeKalb, Illinois

Joseph F. Glidden

Improvement in Wire-Fences

Patent No. 157,124

Born January 18, 1813
Died October 9, 1906

Inducted in 2006

Joseph Glidden's innovative barbed wire was essential to the settlement of the American plains in the late nineteenth century. It proved to be an effective method of securely enclosing one's property, thereby keeping cattle in and trespassers out. Barbed wire has since also proved effective in providing barriers for a variety of places and uses.

Prior to Glidden's wire, there was no practical or effective way to enclose property in the West. Glidden's barbed wire was easy to install and much cheaper to produce than other types of fencing.

The advent of barbed wire, while allowing livestock to be contained, also brought about the end of the great cattle drives. The economic advantages of using barbed wire were apparent in the ability to raise cattle in more controlled conditions.

Glidden made innovations to existing barbed wire designs by creating a double strand of wire that held barbs securely in place. He established the Barb Fence Company to manufacture his wire; it was an immediate success. Glidden eventually sold his interest to the Washburn and Moen Manufacturing Company for $60,000.

Glidden was born in Charlestown, New Hampshire. His wire has outlasted other innovative wires used for enclosure throughout the twentieth century, and it is still used today.

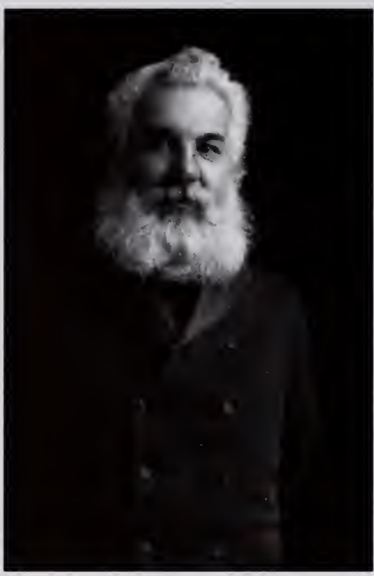


Photo credit: The MIT Museum

Alexander Graham Bell

Improvement in Telegraphy

Patent No. 174,465

Born March 3, 1847
Died August 2, 1922

Inducted in 1974

Alexander Graham Bell's invention of the telephone grew out of his research on improving the telegraph. Born in Edinburgh, Scotland, he spent one year at a private school, two years at Edinburgh's Royal High School, and attended lectures at Edinburgh University and at University College in London, but he was largely family-trained and self-taught.

Bell had the good fortune to discover Thomas Watson, a repair mechanic and model maker, who assisted him in devising an apparatus for transmitting sound by electricity. On April 6, 1875, Bell was granted the patent for the multiple telegraph, which sent two signals at the same time. In September 1875, he began work on the telephone. On March 7, 1876, the U.S. Patent Office granted him Patent Number 174,465 for the telephone. After inventing the telephone, Bell continued his experiments in communication, which culminated with the photophone— transmission of sound on a beam of light—a precursor of today's optical fiber systems. He also worked in medical research and invented techniques for teaching speech to the deaf.

Bell's extensive range of genius included patents for the telephone and telegraph, the photophone, aerial vehicles, and hydro-planes. In addition, he founded the National Geographic Society in 1888.

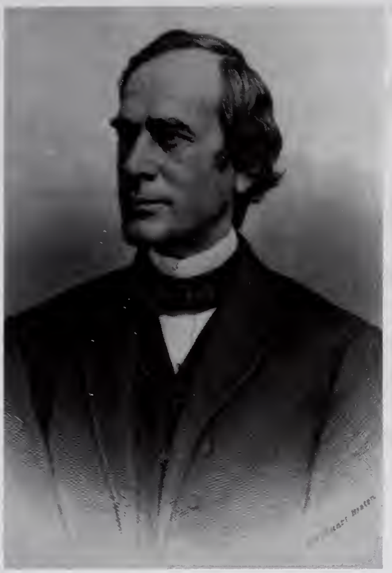


Photo credit: Courtesy of the Library of Congress

George Henry Corliss

Improvement in Valve Gears for Steam-Engines Improvement in Governors for Air-Pump Engines

Patent Nos. 177,059; 177,377

Born June 2, 1817
Died February 21, 1888

Inducted in 2006

George Corliss' innovations greatly enhanced the efficiency and controllability of steam engines. His inventions paved the way for the widespread use of steam power in nineteenth-century America.

Corliss was born in Easton, New York. He left school at age fourteen to be a storekeeper and, after some additional schooling, opened his own shop in 1838. Customer complaints about poorly stitched shoes inspired Corliss to design a machine to stitch leather. He patented the machine in 1842. Soon after, he was hired by a machine and engine building firm where he conceived dramatic improvements in steam engines.

Corliss made his most important contributions to the designs of valves and governors for steam engines. His innovations significantly increased fuel efficiency, a key step in the transition from water to steam power that marked the Industrial Revolution. The inventor later formed his own firm, which became the Corliss Engine Company.

Corliss' design was widely copied, and the fuel economy of reciprocating steam engines has not since been significantly improved. He was awarded a gold medal at the 1867 Paris Exposition, in global competition with over one hundred other engine builders, and the Rumford Medal of the American Academy of Arts and Sciences in 1870.

Photo credit: Courtesy of AT&T Archives & History Center

Thomas A. Watson

Telephone

Patent No. 199,007

Born January 18, 1854
Died December 13, 1934

Inducted in 2011

Thomas Watson is best known for working as Alexander Graham Bell's assistant during the development of the telephone. It was Watson who heard the first words uttered on the telephone: "Mr. Watson–come here–I want to see you." However, more than Bell's assistant, Watson was an inventor in his own right and in the early years of the telephone industry, he contributed over 35 patents which were used by American Bell to establish its place in the market.

Watson, who had been working in an electrical instrument shop, was hired by Bell in 1875. Watson provided the hands-on skills vital to making and operating the devices that demonstrated Bell's ideas about electrically transmitting speech. Through 1876 and 1877, Watson helped Bell demonstrate the telephone. Watson developed a number of improvements over the next few years including a ringer which allowed a caller to signal that he or she was calling someone, a switch that turned off the telephone when the receiver was hung up, a better microphone, and several devices for use on early switchboards. Using Watson's innovations, the Bell Telephone Company was able to improve service and expand its customer base.

After leaving the Bell Telephone Company in 1881, Watson used his patent royalties to found the Fore River Ship and Engine Building Company which would go on to become one of the major shipyards during World War I.

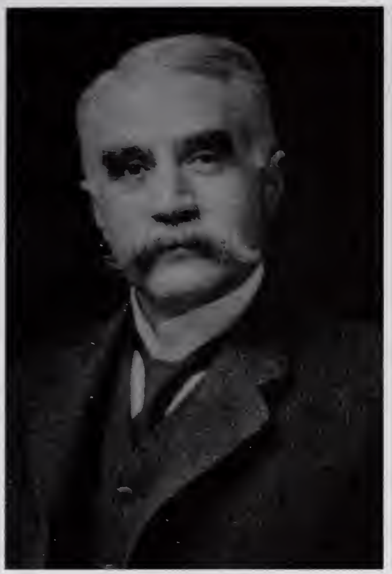


Photo credit: Charles F. Brush Collection, Special Collections, Kelvin Smith Library, Case Western Reserve University

Charles F. Brush

Improvement in Electric Lamps

Patent No. 203,411

Born March 17, 1849
Died June 15, 1929

Inducted in 2006

Charles Brush perfected the system of electric arc lighting, making it practical for commercial use. He installed the first electric light system in the United States in Cleveland, Ohio, in 1879.

Brush was born in Euclid Township, Ohio. He built his first static electric machine at age 12 and constructed his first arc light in high school. After graduating from the University of Michigan on an accelerated schedule, Brush worked as an iron ore salesman and experimented on an improved dynamo in his spare time. Brush's dynamo was key to a commercially viable lighting system and was widely used.

Soon after its introduction in Cleveland, Brush's street lighting system was installed in New York City and London, and before long was lighting cities around the globe. Although the filament light bulb eventually replaced the arc light for many uses, the arc light still is commonly used in searchlights and cinema projection. Of Brush's more than fifty inventions, many were improvements on the arc light.

After retiring from Brush Electric Company in 1891, Brush improved Carl Linde's process for extracting oxygen from liquid air and became founder and first president of the Linde Air Products Company. He also was known for his invention of a more efficient basic storage battery.

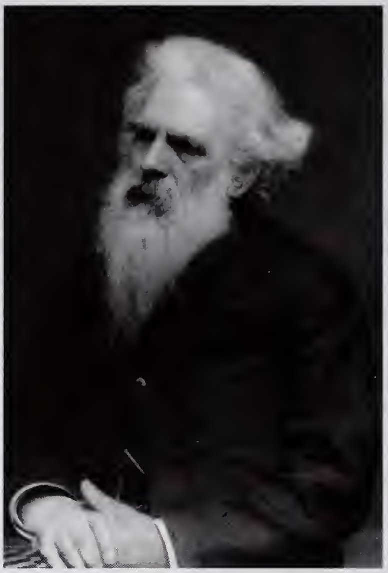


Photo credit: Courtesy of Library of Congress Prints and Photographs Division [LC-USZ62-54835]

Eadweard Muybridge

Method and Apparatus for Photographing Objects in Motion

Patent No. 212,865

Born April 9, 1830
Died May 4, 1904

Inducted in 2011

Eadweard Muybridge made three major achievements in photography: first, the development of a photographic process fast enough to capture bodies in motion; second, the creation of successive images that, mounted together, reconstituted a whole cycle of motion rather than isolating a single moment; and third, their reanimation as a moving picture.

The first achievement occurred in 1877 and required a breakthrough in photochemistry and the development of a very fast shutter. The result was a series of photos of the horse Occident in motion, including the famous photograph depicting the horse frozen in full gait with no feet on the ground.

In 1878, Muybridge developed the process for making rapid sequences of photographs of motion. He used electrical triggers in order not to jar the camera in the act of releasing the shutter. This process allowed for methodical, reliable, and repeatable images. The following year, Muybridge developed the Zoopraxiscope, a device that projected images from rotating glass disks in rapid succession to give the impression of motion.

Muybridge, whose name originally was Edward Muggeridge, was born and died in England although he spent much of his life working in the United States.

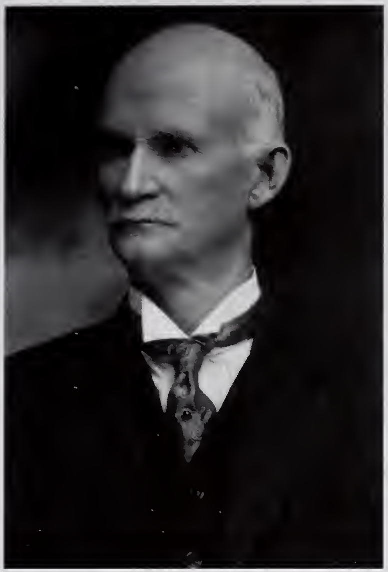


Photo credit: Ogden Union Station Collection

John Moses Browning

Breech-Loading Fire Arm

Patent No. 220,271

Born January 23, 1855
Died November 26, 1926

Inducted in 2007

John Browning advanced the gun industry during the late 19th and early 20th centuries by designing pioneering, commercially successful guns, including the lever-action repeating rifle, semi-automatic shotgun, .22 caliber rifle, the Browning 1919 .30 caliber and M2 .50 caliber machine guns (MGs), and the Browning Automatic Rifle (BAR). Over thirty million modern weapons are based on his designs.

Born in Ogden, Utah, Browning worked in his father's shop, creating his first rifle from scrap iron at thirteen. In 1879, Browning received his first patent for his breech-loading, single-shot rifle, selling the design to the Winchester Repeating Arms Company.

By the 1890s, Browning began developing ways to use gases and recoil from exploding ammunition to automatically eject, reload, and fire guns. He applied this to smaller arms, creating the Colt 1911 .45 semi-automatic pistol that became standard issue for the U.S. military in 1911.

By the end of World War I, the U.S. Army adopted Browning's automatic MGs and procured 57,000 of them for soldiers fighting on the Western Front. Firearms based on Browning's later innovations—including the BAR, 1919 .30 caliber and M2 .50 caliber—became standard issue weapons for the U.S. and numerous NATO country militaries for most of the 20th century.

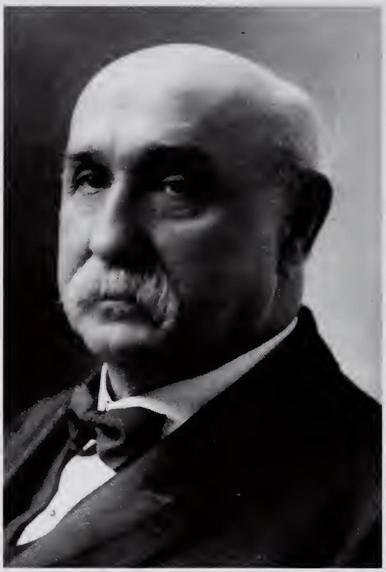


Photo credit: Courtesy of Montgomery County Historical Society

James Ritty

Cash Register and Indicator

Patent No. 221,360

Born October 29, 1836
Died March 29, 1918

Inducted in 2011

Brothers James and John Ritty developed a working version of a mechanical cash register for use at James' saloon in Dayton, Ohio.

In 1878, while on a steamboat trip in Europe, James Ritty became intrigued by a mechanism that counted the revolutions of the ship's propeller. He wondered if something like this could be made to record cash transactions at the saloon he owned. By using a machine to record each sale, he determined it would be possible for both the employer and the customer to check and audit each transaction.

Upon his arrival back home in Dayton, Ritty and his brother John began working on a design for such a device. They worked on several versions, and their third prototype was a success. It operated by pressing a key that represented a specific amount of money. There was no cash drawer yet with their design. Continuing to improve their innovation, the Ritty brothers opened a small factory in Dayton to manufacture cash registers. James Ritty soon became overwhelmed with the responsibilities of operating two businesses and sold the interest in the cash register business to others who renamed the company the National Cash Register Company, later known as NCR.

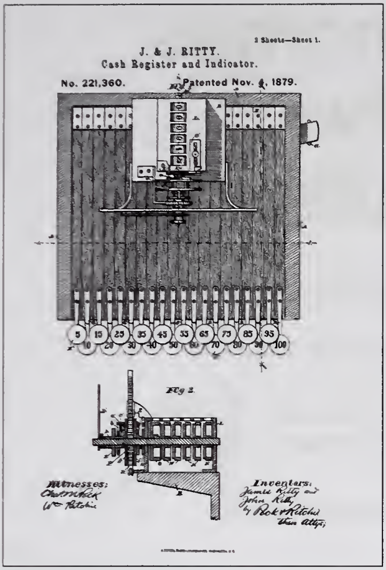


Photo credit: Image of Patent No. 221,360 courtesy of the United States Patent and Trademark Office

John Ritty

Cash Register and Indicator

Patent No. 221,360

Born ca. 1834
Died December 28, 1913

Inducted in 2011

Brothers James and John Ritty invented a working version of a mechanical cash register for use at James' saloon in Dayton, Ohio.

In 1878, while on a steamboat trip in Europe, James Ritty became intrigued by a mechanism that counted the revolutions of the ship's propeller. He wondered if something like this could be made to record cash transactions at his saloon. By using a machine to record each sale, he determined it would be possible for both the employer and the customer to check and audit each transaction.

Upon his arrival back home in Dayton, Ritty and his brother John, a skilled mechanic, began working on a design for such a device. They worked on several versions, and their third prototype was a success. It operated by pressing a key that represented a specific amount of money. There was no cash drawer yet with their design. Continuing to improve their innovation, the Ritty brothers opened a small factory in Dayton to manufacture cash registers. Eventually, they sold the cash register business to others who renamed the company the National Cash Register Company, later known as NCR.

Photo credit: U.S. Department of the Interior, National Park Service, Edison National Historic Site

Thomas Alva Edison

Electric Lamp

Patent No. 223,898

Born February 11, 1847
Died October 18, 1931

Inducted in 1973

One of the outstanding geniuses in the history of technology, Thomas Edison earned patents for over a thousand inventions, including the incandescent electric lamp, the phonograph, the carbon transmitter, and the motion picture projector. He also created the world's first industrial research laboratory. Born in Milan, Ohio, Edison was an inquisitive child. He found the study of chemistry and the production of electrical current from voltaic jars especially absorbing and soon operated a homemade telegraph set.

In 1868, he borrowed a small sum from an acquaintance, and became a freelance inventor, taking out his first patent for an electrical vote recorder. In 1869, Edison was called to try to repair a telegraphic gold-price indicator on Wall Street. This he did so expertly that he was given a job as its supervisor. His work gained notice, and soon he found himself with enough money to manufacture stock tickers and high-speed telegraphs.

In 1876, Edison set up a laboratory in Menlo Park, New Jersey, where he could devote his full attention to invention. He promised that he would turn out a minor invention every ten days and a "big trick" every six months. He also proposed to "make invention to order." Before long he was applying for as many as 400 patents a year. In September 1878, after having viewed an exhibition of 500-candlepower arc lights, Edison announced he would invent a safe and inexpensive electric light to replace gaslights in millions of homes; moreover, he would accomplish this by a different method of distribution than used for arc lights. Leading financial figures joined with Edison to form

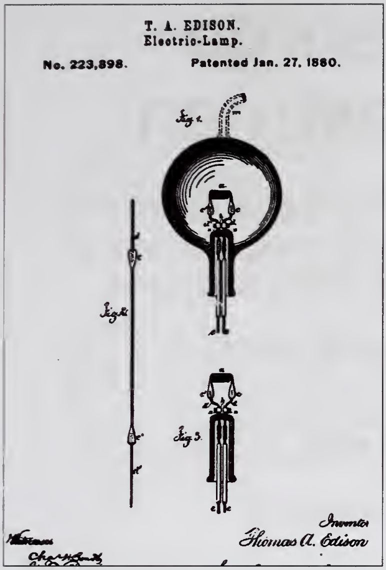


Image of patent drawing 223,898 courtesy of the United States Patent and Trademark Office

the Edison Electric Light Company, the predecessor of today's General Electric Company. On October 21, 1879, Edison demonstrated the carbon-filament lamp, supplied with current by his special high-voltage dynamos. The pilot light-and-power station at Menlo Park glowed with a circuit of 30 lamps, each of which could be turned on or off without affecting the rest. Three years later, the Pearl Street central power station in downtown New York City was completed, initiating the electrical illumination of the cities of the world. In 1887 Edison moved his workshop from Menlo Park to West Orange, New Jersey, where he built the Edison Laboratory (now a national monument), a facility 10 times larger than the earlier one. In time it was surrounded with factories employing some 5,000 persons and producing a variety of new products; among them his improved phonograph using wax records, the mimeograph, fluoroscope, alkaline storage battery, dictating machine, and motion-picture cameras and projectors.

During World War I, the aged inventor headed the Naval Consulting Board and directed research in torpedo mechanisms and antisubmarine devices. It was largely owing to his urging that Congress established the Naval Research Laboratory, the first institution for military research, in 1920.

Photo credit: Courtesy of George Eastman House

George Eastman

Method and Apparatus for Coating Plates for Use in Photography

Patent No. 226,503

Born July 12, 1854
Died March 14, 1932

Inducted in 1977

George Eastman's inventions of dry, rolled film and the hand-held cameras that utilized it revolutionized photography. Born in Waterville, New York, Eastman embarked upon the intricate tasks of preparing the necessary emulsions, coating the "wet plates" on which most pictures were then taken, and developing the prints. He eagerly pursued all available literature on the subject and was attracted by a formula for a "dry plate" emulsion. The formula suggested the possibility of reducing the size and weight of outdoor photographic equipment.

Eastman had in mind the commercial prospects of dry plates and by 1879 was ready to embark on a business career. Patents were secured in England and America on his coating machine, and returns began to flow in from foreign lessees.

Eastman began his search for a transparent and flexible film in 1884. The first commercial film, put into production a year later, was cut in narrow strips and wound on a roller device patented by Eastman. Film rolls sufficient for 100 exposures were mounted in a small box camera—the Kodak, which was introduced in 1888 priced at $25.

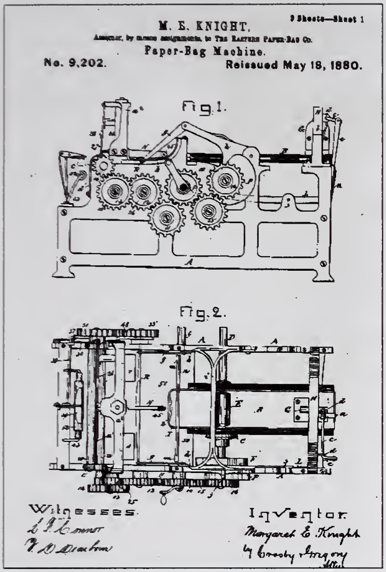


Image of patent no. RE 9,202 courtesy of the United States Patent and Trademark Office

Margaret E. Knight

Improvement in Paper-Bag Machines

Patent No. RE 9,202

Born February 14, 1838
Died October 12, 1914

Inducted in 2006

Margaret Knight invented a machine that could automatically cut, fold, and glue flat-bottomed paper bags. Knight's invention revolutionized the paper bag industry by replacing the work of thirty people with one machine.

Born in York, Maine, Knight went to work in a New Hampshire textile mill following her father's death when she was still a child. After witnessing a serious accident caused by a malfunctioning loom, Knight was inspired to create her first invention, a safety device that became a standard fixture on looms. That device was the first of many technical innovations that would touch a wide range of industries.

Before Knight invented her paper-bag machine, flat-bottomed bags could only be made manually and at great expense. With her innovation, flat-bottomed bags could be mass manufactured, replacing less useful v-shaped bags. Her invention was used worldwide. An updated variation of her machine was still in use at the end of the twentieth century.

Knight founded the Eastern Paper Bag Company in Hartford, Connecticut. Between 1870 and 1915, the inventor was granted patents for at least twenty-six inventions, ranging from a window frame, to a sole-cutting machine for shoemaking, to a compound rotary engine.

Photo credit: Print Collection, Miriam and Ira D. Wallach Division of Art, Prints and Photographs, The New York Public Library, Astor, Lenox and Tilden Foundations

Lester A. Pelton

Water-Wheel

Patent No. 233,692

Born September 5, 1829
Died March 14, 1908

Inducted in 2006

One of the fathers of hydroelectric power, Lester Pelton invented the first water wheel to take advantage of the kinetic energy of water rather than the weight or pressure of a stream. The speed and efficiency of Pelton's wheel made it ideal for generating electricity.

Pelton was born in Vermilion, Ohio. He migrated to California in 1850, in the midst of the Gold Rush. Failing to strike it rich, he worked as a carpenter and millwright. He began developing his water wheel in the late 1870s, as the power demands of mining operations and related industries grew ever greater.

Pelton designed a wheel with split buckets that harnessed the kinetic energy of a small volume of water flowing at high speed. Properly adjusted, Pelton's wheel could be over 90 percent efficient; other wheels were at best 40 percent efficient. With Pelton's wheel, low-cost hydroelectric power could replace expensive steam engines in mining operations in the western states, where streams rarely flowed at high enough volumes to turn traditional water wheels.

To keep up with tremendous demand, Pelton and a San Francisco machine shop owner organized the Pelton Water Wheel Company. Today, Pelton's wheel still generates electricity in small hydroelectric power plants in the western United States.

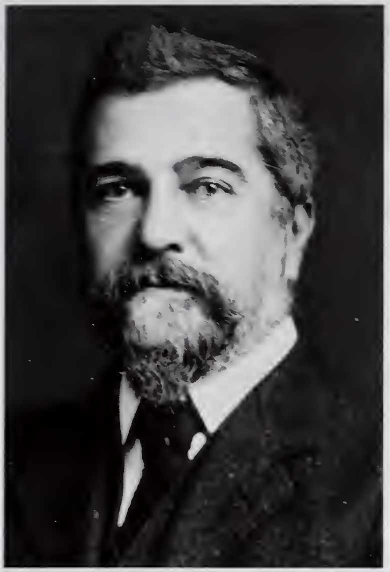


Photo credit: Courtesy of the Library of Congress [LC-USZ62-115996]

Louis Comfort Tiffany

Glass Tile, Mosaic

Patent No. 237,416

Born February 18, 1848
Died January 17, 1933

Inducted in 2007

The son of the founder of Tiffany and Company Jewelers, artist Louis Tiffany is best known for the lamps that bear his name.

In the early 1880s, Tiffany received patents for stained glass and stained glass windows. Tiffany's windows provided a brilliant visual effect by allowing more natural light to penetrate, sometimes incorporating stained glass with a metallic luster to produce an iridescent effect. In 1885, Tiffany established the Tiffany Glass Company and his stained glass windows graced many buildings in the United States.

Tiffany also won acclaim for his favrile glass. Favrile was a colorful glass used by Tiffany when he manufactured his now signature lamps in the mid-1890s. Like Tiffany's stained glass, favrile glass found its way into mosaics and windows that decorated many civic buildings not just around the nation, but around the world.

Born in New York City and educated at the National Academy of Design, Tiffany would establish various companies throughout his lifetime devoted to manufacturing his stained glass and other products. He also established the Louis Comfort Tiffany Foundation in 1918 to provide training to students until financial hardships ended this venture.

Photo credit: U.S. Department of the Interior, National Park Service, Edison National Historic Site

Lewis Latimer

Process of Manufacturing Carbons

Patent No. 252,386

Born September 4, 1848
Died December 11, 1928

Inducted in 2006

Lewis Latimer invented a method for producing a more durable carbon filament, making incandescent lighting practical and affordable for consumers.

Latimer was born in Chelsea, Massachusetts, the son of former slaves. He enlisted in the Union Navy during the Civil War and was a lieutenant in the Massachusetts Volunteer Militia. Working as a self-taught draftsman after the war, Latimer made the drawings for Alexander Graham Bell's first patent application for the telephone. He made his most important innovation in electric light technology while working for the United States Electric Lighting Company in the 1880s.

Latimer's design produced a carbon filament that was more durable and longer lasting than earlier filaments. As a result, incandescent light bulbs became affordable to more consumers. Safer than gas lamps, and less harsh than arc lights, incandescent bulbs transformed the average American home after nightfall.

Despite the societal roadblocks a black man faced in the late nineteenth century, Latimer successfully oversaw the set up of electric lighting plants in the United States, Canada, and England. After leaving U.S. Electric Lighting, Latimer worked for Thomas Edison and became a patent investigator and expert witness for the Edison Electric Light Company.

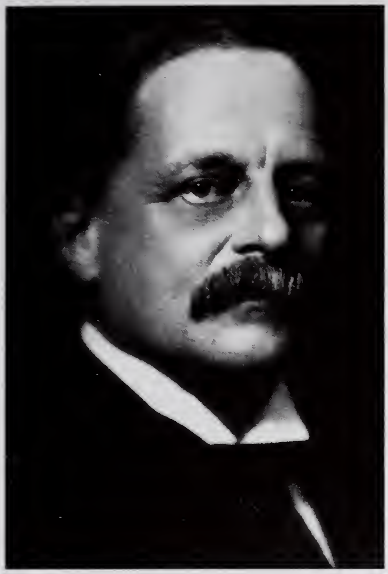


Photo credit: Courtesy of IEEE History Center

Elihu Thomson

Electric-Arc Lamp

Patent No. 258,684

Born March 29, 1853
Died March 13, 1937

Inducted in 2006

Possessing the ability to translate theory into practice, Elihu Thomson was an integral contributor to the development of electricity as a power and light source during the turn of the 20th century.

One of Thomson's earliest inventions was the three-coil arc dynamo, which was the basis of the successful electric lighting system produced by the Thomson-Houston Electric Company. The success of his arc lighting installation led to the large-scale manufacturing of arc-lighting equipment, which included dynamos, arc lights, and minor accessories. Thomson continued to perfect his arc-lighting system, making the dynamo more compact, efficient and of larger capacity. In 1892 the company merged with the Edison General Electric Company to become the General Electric Company. In the early years of the new company, Thomson was elected chief engineer, producing many of the fundamental inventions that brought General Electric success.

Born in Manchester, England, Thomson moved to the United States and was educated through high school in Philadelphia, Pennsylvania. One of the most prolific inventors in history, Thomson earned 696 patents.

Photo credit: *Courtesy of the Moorland Springarn Research Center, Howard University*

Jan Ernst Matzeliger

Lasting-Machine

Patent No. 274,207

Born September 15, 1852
Died August 24, 1889

Inducted in 2006

Jan Matzeliger invented the automatic shoe lasting machine, mechanizing the complex process of joining a shoe sole to its upper, and revolutionizing the shoe industry.

Matzeliger was born in Surinam (now Dutch Guiana) and was self-educated. He immigrated to the United States at age twenty, and ran a shoe-stitching machine for a manufacturer in Lynn, Massachusetts. Observing the hand lasters at the factory, he resolved to mechanize the one remaining manual bottoming process. With reference books and a secondhand set of drafting instruments, Matzeliger worked on his own time after long days at the factory. He built his first model out of wooden cigar boxes, elastic, and wire. After two years, his prototype was complete.

Because of the complex movements required to stretch shoe leather around a last, and the importance of the lasting process to the final look of a shoe, earlier attempts to mechanize the process had failed. Matzeliger's device was so complex that patent examiners had to see it in operation to understand it.

Matzeliger improved his invention until it could produce 700 pairs of shoes per day, a dramatic increase from the fifty pairs a skilled laster could make by hand. Shoe prices dropped by nearly half, making quality shoes affordable to a great number of people for the first time.

Photo credit: Collection of the New York Historical Society

Lewis Edson Waterman

Fountain-Pen

Patent No. 293,545

Born November 20, 1837
Died May 1, 1901

Inducted in 2006

Lewis Waterman invented a superior fountain pen that made inkwells and dip pens obsolete.

Waterman was born in Decatur, New York. With only five years of schooling, he worked as a teacher, carpenter, and book salesman before becoming an insurance agent. He is said to have vowed to invent a better writing instrument when an inferior pen leaked on an important insurance contract, delaying him long enough that he lost the client.

Waterman improved on earlier fountain pen designs by including a nib and feed mechanism that produced a steady flow of ink. He founded the Ideal Pen Company (later the L.E. Waterman Company) in New York in 1884, to manufacture his pen while he continued to improve its design. In addition to being functionally superior, Waterman pens were well-balanced and aesthetically pleasing; some had gold and silver overlays, and others were studded with gems. A Waterman pen won the Medal of Excellence at the Paris World Exposition in 1900.

By 1901, Waterman was selling 1,000 pens per day. They remained popular until the Great Depression made them an impractical luxury for many. After World War II, disposable ballpoint pens came to dominate the industry. Nonetheless, high-quality Waterman fountain pens are still made today in a wide variety of styles.

Photo credit: Courtesy of Kalamazoo Gazette

William E. Upjohn

Process of Making Pills

Patent No. 312,041

Born June 5, 1853
Died October 18, 1932

Inducted in 2006

William Upjohn invented the first dissolvable pill and the means for its mass production in 1884.

Born in Richland, Michigan, Upjohn grew up when medicines were commonly administered in powdered form. Once pills were created, they were not practical or effective since the outer shell was hard and did not allow the stomach to digest them properly. By 1880, Upjohn began developing a friable pill – a pill the thumb could crush – that did not harden and dissolved easily in the stomach. In 1884 he invented a machine to mass-produce these pills with a regulated dosage. In 1886, the Upjohn Pill and Granule Company was established, producing these new pills on a massive scale. The company would manufacture 186 different medications in pill form over the next century. This dissolvable pill is similar to what is in use today.

Shortening its name to the Upjohn Company, the company expanded its pills into a full array of pharmaceutical products in 1902. A multi-billion dollar business, the Upjohn Company was a leader in the pharmaceutical industry for over 100 years. After Upjohn merged with Swedish-based Pharmacia AB, renamed the Pharmacia Corporation in 1995, it was purchased by Pfizer in 2002.

Photo credit: Corbis-Bettmann

Ottmar Mergenthaler

Machine for Producing Printing Bars

Patent No. 317,828

Born May 10, 1854
Died October 28, 1899

Inducted in 1982

Ottmar Mergenthaler's invention of the linotype composing machine in 1885 is regarded as the greatest advance in printing since the development of moveable type 400 years earlier.

Born in Germany, Mergenthaler was trained as a watch and clockmaker. He arrived in Baltimore in 1872 and took a job in a machine shop, eventually working his way up into a partnership. At the age of 31 he designed and built his first linotype machine. With it, the two operations of setting and casting type in leaden lines were performed simply by touching the keys of a board similar to the keyboard of a typewriter.

Mergenthaler's machine enabled one operator to be machinist, type-setter, justifier, typefounder, and type-distributor. Since the machine was first used in 1886 by the *New York Tribune*, great improvements on its design have been made. Probably more than 1,500 separate patents have been taken out in connection with it.

Photo credit: Photo from wikipedia.com

Frank J. Sprague

Electric Railway System

Patent No. 321,149

Born July 25, 1857
Died October 25, 1934

Inducted in 2006

Hailed during his lifetime as the "Father of Electric Traction," Frank Sprague's achievements in horizontal transportation were paralleled by equally remarkable achievements in vertical transportation. During a six-decade career, Sprague developed the electric railway, early electric elevators, and the commercial electric motor.

Born in Milford, Connecticut, Sprague graduated from the U.S. Naval Academy in 1878. After the Academy, he developed a number of significant inventions. The first was a constant-speed, non-sparking motor with fixed brushes, the first motor to maintain constant revolutions per minute under different loads. Sprague's company sold 250 motors in two years. Sprague also designed a method to regenerate – or return – power to the main supply systems of electric motor-driven equipment, such as elevators and trains. The method was later used extensively on mountain grades in electrical train operation and for interchange of energy in elevator groups.

Sprague incorporated many of these inventions in the equipment his company installed for the Richmond, Virginia, Union Passenger Railway in 1888. Within two years of its opening, 110 electric railroads using Sprague's equipment were built or under contract, including systems in Italy and Germany.

1886-1913
The American System of Manufacture

Mass production, the specialization of labor, and the use of interchangeable parts accelerated the growth of U.S. industry at the turn of the century. By 1914, these methods were applied in large-scale assembly lines for the production of automobiles. In addition, inventors in the emerging field of electrical engineering created new power distribution systems. This availability of electricity inspired inventions for everything from making toast to powering lights. Innovations in chemistry and the theory of germs as a cause of disease created inventive opportunities in food preservation, medicine, and public health. To promote these new fields, universities established schools for engineering and doctoral programs for the sciences. Companies formed their own industrial laboratories to create new marketable products. The American public honored inventors as architects of a new world during this age of production.

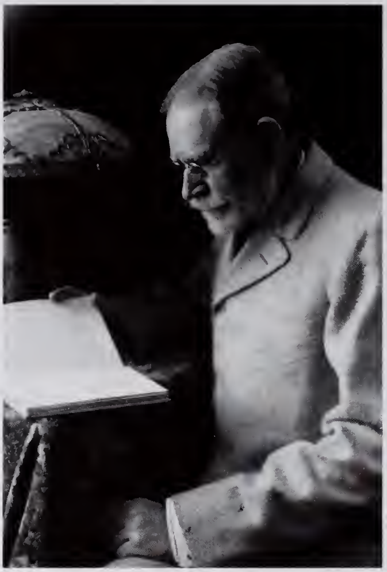


Photo credit: Charles Sumner Tainter Papers, National Museum of American History, Behring Center, Smithsonian Institution

Charles Sumner Tainter

Apparatus for Recording and Reproducing Sounds

Patent No. 341,288

Born April 25, 1854
Died April 20, 1940

Inducted in 2006

Charles Tainter invented various sound-recording instruments, including an improved version of Thomas Edison's phonograph known as the graphophone, the photophone, and the dictaphone.

Born in Watertown, Massachusetts, Tainter, a self-educated man, began working for electrical and optical instrument companies in Boston, Massachusetts in 1870. His experience led him to establish his own business, where he worked with Alexander Graham Bell making electrical devices. After Tainter contributed to Bell's first transmission of sound, the duo created the radiophone, an instrument that used light waves and selenium cells to transmit wireless sound.

Tainter continued working with recorded sound, collaborating with Bell and Bell's cousin, Chichester A. Bell, to develop the graphophone. The trio devised a method to photograph speech vibrations using a wax-coated cardboard cylinder and flexible recording needle, both of which were superior to Edison's phonograph. Tainter also invented the dictophone. Its immediate success as a device used to record speech for later playback led to other inventors, including Thomas Edison, imitating Tainter's breakthroughs. Receiving several important patents in 1886, Tainter shaped the future of the recording industry.

Photo credit: Courtesy of George Stanley

William Stanley, Jr.

Induction-Coil

Patent No. 349,611

Born November 28, 1858
Died May 14, 1916

Inducted in 1995

In the 1880s every system for distributing electricity used direct current (DC). But DC transmission over long distances was impractical. Transmitting at low voltage required thick wires. Transmitting at high voltage was dangerous and could not be reduced for consumer uses such as lighting. It was known that alternating current (AC) voltage could be varied by use of induction coils, but no practical coil system had been invented. William Stanley's design for such a coil—or "transformer" as it is now called—became the prototype for all future transformers.

Born in Brooklyn, New York, Stanley enrolled at Yale University. However, he soon left school to look for a job in the emerging field of electricity. Eventually, Stanley joined Hiram Maxim, pioneer in the electrical industry. George Westinghouse learned of Stanley's accomplishments and hired him as chief engineer at his Pittsburgh factory where he began work on the transformer. Because of ill health, Stanley left Pittsburgh for Great Barrington, Massachusetts.

In 1886, he demonstrated the first AC system, providing lighting for offices and stores on the town's Main Street. Stanley established the Stanley Electric Manufacturing Company in Pittsfield, Massachusetts, to make transformers, auxiliary electrical equipment, and electrical appliances.

Photo credit: Photo courtesy of Hobart

Josephine Garis Cochran

Dish-Washing Machine

Patent No. 355,139

Born 1839
Died August 3, 1913

Inducted in 2006

Josephine Cochran invented the first practical dishwasher and formed the Garis-Cochran Dish-Washing Company to manufacture and market it.

Cochran was born in Ohio. After moving to Illinois, Cochran set out to design a washing device after commonly finding plateware chipped from hand washing. She designed a set of wire compartments, each created to fit plates, cups, or saucers. The compartments were placed inside a wheel that lay flat inside a copper boiler, while a motor turned the wheel, pumping hot soapy water from the bottom of the boiler. The machine was showcased in the World Columbian Exposition of 1893, helping to establish a market for the dishwasher in hotels and large restaurants.

Since most homes' hot water heaters could not supply the amount of hot water the dishwasher required, the machine's large size limited the company's sales. It was not until the 1950s that increased availability of hot water in the home, effective dishwashing detergent, and a change in attitudes toward housework made dishwashers popular with the general public. The Garis-Cochran Manufacturing Company became part of KitchenAid®, and in 1949, the first KitchenAid dishwasher—based on Cochran's design—was introduced to the public. Today, the dishwasher is a standard appliance in most American households.

Photo credit: Mercedes-Benz Archives

Nicolaus August Otto

Gas-Motor Engine

Patent No. 365,701

Born June 10, 1832
Died January 26, 1891

Inducted in 1981

Engineer Nicolaus August Otto invented the first practical alternative to the steam engine. Born in Holzhausen, Germany, Otto built his first gas engine in 1861. Then, in partnership with German industrialist Eugen Langen, they improved the design and won a gold medal at the Paris Exposition of 1867. In 1876, Otto, then a traveling salesman, chanced upon a newspaper account of the Lenoir internal combustion engine.

Before year's end, Otto had built an internal combustion engine, utilizing a four-stroke piston cycle. Now called the "Otto cycle" in his honor, the design called for four strokes of a piston to draw in and compress a gas-air mixture within a cylinder resulting in an internal explosion.

Although an earlier patent by French engineer Alphonse de Rochas was found, Otto built the first practical and successful four-stroke cycle engine. Because of its reliability, efficiency, and relative quiet, more than 30,000 Otto cycle engines were built in the next ten years.

Photo source: New Negro for a New Century, Booker T. Washington, reprinted 1969

Alexander Miles

Improved Method for Opening and Closing Elevator Doors

Patent No. 371,207

Born 1838
Died (date unknown)

Inducted in 2007

Alexander Miles, who contributed to the elevator industry, was an African-American inventor of the late 19th century who transcended racial barriers in the United States.

Miles, born in Duluth, Minnesota, designed an elevator that was able to open and close its own doors and the elevator shaft doors. When the elevator would arrive or depart from a given floor, the doors would move automatically. Previously, the opening and closing of the doors of both the shaft and the elevator had to be completed manually by either the elevator operator or by passengers, contributing greatly to the hazards of operating an elevator.

Miles attached a flexible belt to the elevator cage, and when the belt came into contact with drums positioned along the elevator shaft just above and below the floors, it allowed the elevator shaft doors to operate at the appropriate times. The elevator doors themselves were automated through a series of levers and rollers.

The influence of his elevator patent is still seen in modern designs, since the automatic opening and closing of elevator and elevator shaft doors is a standard feature.

Photo credit: *Maker of the Microphone Archive*

Emile Berliner

Gramophone; Combined Telegraph and Telephone

Patent Nos. 372,786; 463,569

Born May 20, 1851
Died August 3, 1929

Inducted in 1994

Emile Berliner invented the microphone that became part of the first Bell telephones, and his gramophone was the first record player to use disks. Born in Hanover, Germany, Berliner studied part time at the Cooper Institute (now Cooper Union) while assisting in a chemical laboratory. Berliner was one of many who explored ways of improving the original telephone.

The carbon microphone transmitter he developed varied the contact pressure between two terminals as a voice acted against it. Berliner sold his patent for $50,000 to the fledgling Bell Telephone Company. Berliner's gramophone differed from its contemporaries in that it used a flat disk to record sound rather than the cylinder proposed by Edison. The disk permitted inexpensive, mass duplication. Berliner's gramophone and method for duplicating records were ultimately acquired by the Victor Talking Machine Company (eventually RCA). Berliner also founded Deutsche Grammophon and Britain's Gramophone Co., Ltd. to market his device in Europe.

His trademark, later adopted by RCA, was an amusing painting of a dog listening to "his master's voice." In 1911 he established the Esther Berliner (his mother) Fellowship to give qualified women the opportunity to continue scientific research.

Photo credit: Courtesy of the Ohio Historical Society

Granville Woods

Railway Telegraphy

Patent No. 373,383

Born April 23, 1856
Died January 30, 1910

Inducted in 2006

A prolific inventor, Granville Woods developed the railroad telegraph, a device that transmitted messages, through static electricity, between moving trains.

Born in Columbus, Ohio, Woods was formally educated until the age of ten when he took a job in a machine shop. In 1885 Woods began working on what he called "telegraphony," a device that allowed users to switch between two forms of communication, voice or Morse code, to transmit messages.

Based on "telegraphony," Woods invented the induction telegraph in 1887. Prior to its creation, moving trains were unable to communicate with each other or with rail stations, resulting in dangerous situations. The induction telegraph used static electricity from the existing telegraph lines running parallel to the train tracks, making messaging possible between moving trains and rail stations.

Woods' later inventions dealt with more efficient use of electricity. He created an overhead conducting system for rail and trolley cars to run on electric current instead of steam power. In addition, he devised a third rail that is still often used on many rail lines; the third rail carries electricity via electromagnetic switches and pulls trains along. He also improved the automatic air brake used by railroad cars. His patents were eventually bought and used by General Electric and the Westinghouse Air Brake Company.

Photo credit: Courtesy of The Smithsonian Institution

Nikola Tesla

Electro-Magnetic Motor

Patent No. 381,968

Born July 10, 1856
Died January 7, 1943

Inducted in 1975

Nikola Tesla invented the induction motor with rotating magnetic field that made unit drives for machines feasible and made AC power transmission an economic necessity. Born in Smiljan, Croatia, the son of a Serbian Orthodox clergyman, Tesla attended Joanneum, a polytechnic school in Graz and the University of Prague for two years. He started work in the engineering department of the Austrian telegraph system, then became an electrical engineer at an electric power company in Budapest and later at another in Strasbourg.

While in technical school, Tesla became convinced that commutators were unnecessary on motors; while with the power company, he built a crude motor which demonstrated the truth of his theory. In 1884, Tesla came to the United States and joined the Edison Machine Works as a dynamo designer. In 1887 and 1888 Tesla had an experimental shop at 89 Liberty Street, New York, and there he invented the induction motor. He sold the invention to Westinghouse in July 1888 and spent a year in Pittsburgh instructing Westinghouse engineers.

Tesla obtained more than 100 patents in his lifetime. Despite his 700 inventions Tesla was not wealthy. For many years he worked in his room at the Hotel New Yorker, where he died.

Photo credit: Burroughs Corporation Records, Charles Babbage Institute, University of Minnesota

William Seward Burroughs

Calculating Machine

Patent No. 388,116

Born January 28, 1857
Died September 14, 1898

Inducted in 1987

William Seward Burroughs invented the first practical adding and listing machine. Born in Rochester, New York, Burroughs began his career as a bank clerk. Working in a bank inspired the young inventor with a vision of a mechanical device that would relieve accountants and bookkeepers of the monotony of their tasks and ensure that a smaller percentage of their time was spent correcting errors.

Burroughs began work on his mechanical accounting device shortly after moving to St. Louis in 1882. A machine shop owner gave him a work space and provided him with a young assistant, Alfred Doughty, later president of the Burroughs Adding Machine Company. Burroughs received a patent in 1888 for his "Calculating Machine." Burroughs and several St. Louis businessmen formed the American Arithometer Co. to market the machine. The calculating machine, however, proved to be inaccurate in everyday use, so Burroughs received a patent in 1893 for an improved calculating machine.

Burroughs retired from his company in 1897 due to poor health and moved to Citronelle, Alabama. By 1898 more than 1,000 machines had been sold, and by 1926 the company, renamed the Burroughs Adding Machine Company, had produced a million machines.

Photo credit: Image of Edward Weston [c. 1900], courtesy of the Edward Weston (1850-1936) Papers, Weston Rare Book Room, Robert W. Van Houten Library, New Jersey Institute of Technology, Newark, NJ 07102-1982

Edward Weston

Electrical Measuring Apparatus

Patent No. 392,387

Born May 9, 1850
Died August 20, 1936

Inducted in 2006

Edward Weston advanced the nascent electrical industry by inventing portable electrical measuring instruments that were known worldwide for their precision and dependability.

Born in Wolverhampton, England, Weston was trained in physics, chemistry, and medicine. He immigrated to the United States in 1870 and worked for a New York City electroplating firm. There, he became interested in electricity and improved the dynamo, increasing its efficiency from forty percent to over ninety percent. He formed a company to produce his dynamos, which later focused on improved arc lighting and was acquired by the United States Electrical Lighting Company. As chief electrical engineer, Weston made some of his most important inventions.

In 1884, Weston discovered stable-resistance alloys that made accurate electrical measuring instruments possible. In 1888, he invented the first highly accurate, direct-reading, direct current, portable voltmeter. A complete line of devices for both direct current and alternating current soon followed. In 1932, Weston produced the first direct-reading light meter, which was both accurate and simple to use.

Weston was awarded the Franklin Medal of the Franklin Institute. A prolific inventor, he held over 300 U.S. patents at the time of his death.

Photo credit: Herman Hollerith Collection, Prints & Photographs Division, Library of Congress

Herman Hollerith

Art of Compiling Statistics; Apparatus for Compiling Statistics

Patent Nos. 395,781; 395,782; 395,783

Born February 29, 1860
Died November 17, 1929

Inducted in 1990

Herman Hollerith invented and developed a punch-card tabulation machine system that revolutionized statistical computation. Born in Buffalo, New York, Hollerith enrolled in the City College of New York at age 15 and graduated from the Columbia School of Mines with distinction at the age of 19. Hollerith began working on the tabulating system while teaching mechancal engineering at the Massachusetts Institute of Technology, filing for the first patent in 1884.

He developed a hand-fed "press" that sensed the holes in punched cards; a wire would pass through the holes into a cup of mercury beneath the card closing the electrical circuit. This process triggered mechanical counters and sorter bins and tabulated the appropriate data.

Hollerith's system–including punch, tabulator, and sorter–allowed the official 1890 census count to be tallied in six months; in another two years all of the census data was completed and defined. The cost was $5 million below the forecasts and saved more than two years' time. His later machines mechanized the card-feeding process, adding numbers, and sorted cards, in addition to merely counting data. In 1896 Hollerith founded the Tabulating Machine Company, forerunner of the Computer Tabulating Recording Company (CTR). In 1924 CTR changed its name to IBM–the International Business Machines Corporation.

Photo credit: Image in Public Domain

Carl Auer von Welsbach

Incandescent Device

Patent No. 349,611

Born September 1, 1858
Died August 4, 1929

Inducted in 2011

Carl Auer von Welsbach, an Austrian scientist and inventor, had a talent for discovering techniques for purifying rare earth elements and using these elements to create valuable products. A graduate of the University of Vienna and the University of Heidelberg, he is particularly well known for inventing the gas mantle, which brought light to the streets of Europe in the late 19th century. He also invented the metal filament light bulb and the flint used in modern lighters.

In 1885, Welsbach patented a gas mantle which he called Auerlicht, using a chemical mixture of magnesium oxide, lanthanum oxide, and yttrium oxide. To produce a mantle, guncotton was impregnated with this mixture and then heated; as the cotton burned away, it left a solid but fragile ash which glowed brightly when heated.

Although Thomas Edison's incandescent lamp was spreading rapidly at this time, Welsbach's mantle allowed the gas industry to slow the spread of electric lighting since lamps equipped with Welsbach mantles provided efficient illumination in many situations. Welsbach continued improving his mantles to develop a metal filament mantle from osmium, and though originally intended to be a new mantle, Welsbach quickly realized he could substitute the osmium for the carbon filament in the incandescent lighting. Welsbach's metallic filament bulb was a huge improvement on the existing carbon filament design, lasting much longer, using less electricity, and proving more robust.

Photo credit: Oberlin College Archives

Charles Martin Hall

Manufacture of Aluminum

Patent No. 400,665

Born December 6, 1863
Died December 27, 1914

Inducted in 1976

Charles Martin Hall discovered the electrolytic method of producing aluminum cheaply, bringing the metal into wide commercial use. As a young chemist experimenting in a woodshed, Charles Hall invented a method for extracting pure aluminum from its ore. Understanding aluminum's potential, Hall founded an industry that contributed to many others, particularly the manufacture of aircraft and automobiles.

Born in Thompson, Ohio, Hall was a student at Oberlin (Ohio) College when he became interested in producing aluminum inexpensively. He continued to use the college laboratory after his graduation in 1885 and discovered his method eight months later. After several unsuccessful attempts to interest financial backers, he obtained the support of Alfred E. Hunt and a few of his friends. Together they formed the Pittsburgh Reduction Company (later the Aluminum Company of America). In 1890 Hall became company vice president.

By 1914 Hall's process had brought the cost of aluminum down to 18 cents a pound. Aluminum, once a precious metal used for fine jewelry, is now inexpensive enough for everyday packaging. Hall became a generous benefactor of his alma mater, bequeathing Oberlin more than $5 million.

Photo credit: Esther Duke Archives, Westtown School, Westtown, PA

Samuel Leeds Allen

Sled

Patent No. 408,681

Born May 5, 1841
Died November 26, 1918

Inducted in 2007

Samuel Allen's most famous invention was a device that rested in winter-time recreation: the Flexible Flyer Sled.

Allen was born in Philadelphia, Pennsylvania, and sent at age eleven to a Quaker boarding school, graduating in 1859. Following his schooling, Allen moved to his father's farm in New Jersey to learn the techniques of farming, creating farming equipment from his own designs. By 1881, Allen established his own company for manufacturing and selling his tools across the United States and Europe.

Spawned from his agricultural inventions were different types of sleds, including his successful Flexible Flyer design. Allen's previous sleds were essentially bobsleds and used a double pair of runners, the small sizes of which made the sled difficult to steer. Determined to create a sled that would be easier to control, Allen settled upon a design that utilized a single pair of T-shaped runners in cross-section, which were flexible and allowed the rider to better control the sled. This sled was dubbed by Allen as the Flexible Flyer.

Although Allen's original company would be sold to the Los Angeles-based Leisure Group in 1968, and further manufacture of the sled was entrusted to Blazon, Inc. in 1973, production of the Flexible Flyer sled continues to this day.

Frederick Ellsworth Sickels

Valve for Steam-Engines

Patent No. 424,581

Born September 20, 1819
Died March 8, 1895

Inducted in 2007

Frederick Ellsworth Sickels is considered one of the pioneers of steam engines. Sickels, born in Gloucester County, New Jersey, invented an improvement on the valve gear of steam engines that permitted them to run far more efficiently, helping spur the widespread adoption of steam engines in American industry.

While working in a steam-engine shop in 1842, Sickels developed his most important invention, a valve mechanism that closely regulated the entry and exit of steam into steam cylinders. He sold his patent rights, and engines based on his design began to appear by 1845. The patent royalties from his valve gear made Sickels reasonably wealthy, but he spent most of his profits on an ultimately unsuccessful patent infringement lawsuit.

Sickels also invented steam-powered steering gear for ships. His prototype used two small steam engines to move the rudder of a ship. This permitted one person to steer a ship with ease, replacing the labor-intensive manual steering gear and the traditional setup that required two men at the wheel at all times. Sickels was unable to convince a major backer to try the system, however, and he had to give up on it in the 1870s. Steam-powered steering gear became quite common by the 1890s, but by then the patent on Sickels' design had expired.

Photo credit: Courtesy of the Library of Congress

Hiram S. Maxim

Manufacture of Explosives

Patent No. 430,212

Born February 5, 1840
Died November 24, 1916

Inducted in 2006

Hiram Maxim produced an array of inventions, but is most known for the Maxim gun, a weapon that completely changed the technique of modern warfare.

Although other guns preceded, the Maxim automatic gun was the first efficient weapon of its class. Its principles first articulated by Maxim in his 1884 patent, Maxim's gun fired eleven shots per second and used the recoil energy of the shot to extract the old cartridge, load a new one, and fire automatically. Maxim also used a water jacket to cool the gun's single barrel. As a result, the Maxim gun was lighter and more portable than traditional weapons and could be transported easily and fired by a small crew. In World War I both sides used guns of Maxim's design.

Maxim's other significant contribution to the art of warfare, smokeless gunpowder, was patented seven years after his machine gun, in 1890. Early gunpowder formulas produced a large cloud of smoke that obscured the battlefield. This posed a particular problem with a high rate of fire, such as that produced by his machine gun. Maxim worked with his brother, Hudson Maxim, to develop a formula that nearly eliminated the smoke associated with traditional gunpowder.

Born in Sangerville, Maine, Maxim remained an active inventor, experimenting with steam-driven airplanes into old age.

Photo source: The Commerce of Rubber: the First 250 Years, Austin Coates, 1987

John Boyd Dunlop

Wheel-Tire for Cycles

Patent No. 435,995

Born February 5, 1840
Died October 23, 1921

Inducted in 2006

Scotsman John Dunlop developed the first practical pneumatic tire in 1888. His tire provided the foundation for the Dunlop Tire Company and served as the genesis for the modern tire industry.

Dunlop was born in Aryshire, Scotland, where he practiced as a veterinary surgeon. In 1887, he began working on a way to make his son's tricycle ride more comfortable. His practical ingenuity led him to cut up an old garden hose, make it into a tube, pump it up with air, and fit it to the rear wheels of the tricycle. After numerous tests and patent litigation, Dunlop patented his pneumatic tire in Great Britain in 1888 and secured a United States patent in 1890.

Irish industrialist W. H. Du Cros became interested in Dunlop's invention and organized a company with Dunlop, the Dunlop Rubber Company. The Dunlop tire became the standard for bicycles. In 1890, with the emergence of the first automobile, Dunlop tires began evolving into a thicker tread tire used for automobiles. Michelin, Dunlop's competitor, used Dunlop's premises to create the first automobile tire. After the growing popularity of the automobile at the beginning of the twentieth century, the demand for more durable rubber compounds grew exponentially.

Photo credit: La Porte County Historical Society Museum

Almon Brown Strowger

Automatic Telephone-Exchange

Patent No. 447,918

Born October 19, 1839
Died May 26, 1902

Inducted in 2006

Almon Strowger, an undertaker from Kansas City, Missouri, invented a mechanism that revolutionized the telephone industry and controlled telephone networks worldwide for much of the twentieth century.

Strowger was born in Penfield, New York, one of seven brothers. He was a schoolteacher and served in the Union cavalry in the Civil War before taking up the profession of undertaking. Frustration over human telephone operators misdirecting his customers' calls is said to have inspired Strowger to invent the automatic telephone switching system.

Strowger's device consisted of buttons a caller tapped to signal the desired number to a central switch, and a rotating arm at the central switch that moved the caller's line until it was in contact with the desired number. Strowger designed each unit to make a large number of lines available and to be combinable to scale dramatically without increasing complexity. The first automatic telephone exchange was installed in La Porte, Indiana in 1892.

The inventor incorporated Strowger Automatic Telephone Exchange in 1891. With enhancements to his original design, including a rotary dial, Strowger's switching devices were standard equipment in telephone systems worldwide until the advent of touch-tone dialing in the late 1970s.

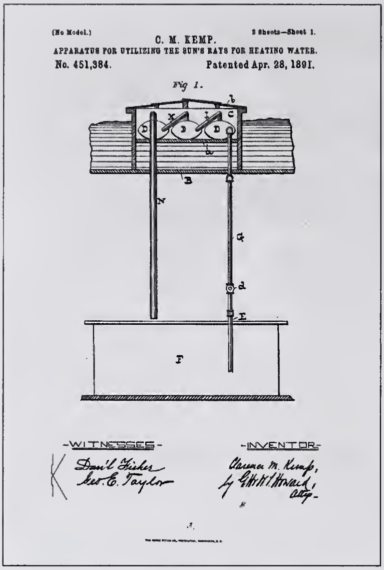


Photo credit: Image of Patent No. 451,384 courtesy of the United States Patent and Trademark Office

Clarence Kemp

Apparatus for Utilizing the Sun's Rays for Heating Water

Patent No. 451,384

Born (Date Unknown)
Died 1911

Inducted in 2011

In 1881, Clarence Kemp founded the C.M. Kemp Manufacturing Company in Baltimore to manufacture many products of his own design, including valves, motors, and equipment for utilizing acetylene. In 1891, Kemp patented a commercial solar water heater that he called the Climax system. During this time many people secured hot bathwater using a "wet-back" wood stove or range in which water was heated via a coiled pipe that passed through the stove. Kemp thought it unpleasant to heat up the stove during the hot Maryland summers.

Instead, his invention consisted of three tanks mounted in a frame under glass on the south side of the roof of a house. The tanks were filled with cold water from the water mains, heated by the sun, and then used for bathing or other purposes. By enclosing the tanks in the frame, Kemp ensured the tanks were somewhat insulated and didn't lose heat to the wind. Today's modern passive solar water heaters follow Kemp's basic design. In 1895, Kemp sold the exclusive manufacturing rights of the heater system to two Pasadena businessmen who found the sunny climate of southern California a more promising market.

Photo credit: Courtesy of Crayola

Edwin Binney

Apparatus for the Manufacture of Carbon-Black

Patent No. 453,140

Born November 24, 1866
Died December 17, 1934

Inducted in 2011

In 1885, Edwin Binney, with his cousin C. Harold Smith, took over his father's lamp black factory and established Binney & Smith. The company quickly became a leader in manufacturing carbon black.

Carbon black was used for paint, printing ink, and enameled leather. Later applications included stove and shoe polishes, coloring paper, pencils and crayons, and ink for high-speed printing presses. The partners created a Pigment Division, introducing carbon black for reinforcing automobile tires; before, tires were typically white.

In the early 1900s, the company created the first dustless white chalk and received a Gold Medal at the 1904 St. Louis World's Fair.

In 1903 Binney and Smith noticed the need for a safe, quality wax crayon. They were confident the pigment and wax mixing techniques they had developed could be adapted for a variety of safe colors. The name "Crayola" was created by Binney's wife, combining the French word *craie* (chalk) with *oléagineux* (meaning oily). The first box contained eight pieces (black, brown, blue, red, purple, orange, yellow, and green) and sold for five cents.

Binney was known not only for his impeccable business sense and innovation but also for his integrity and goodwill. He was a philanthropist who cared about his community and an entrepreneur whose vision encompassed the economic possibilities of a growing nation.

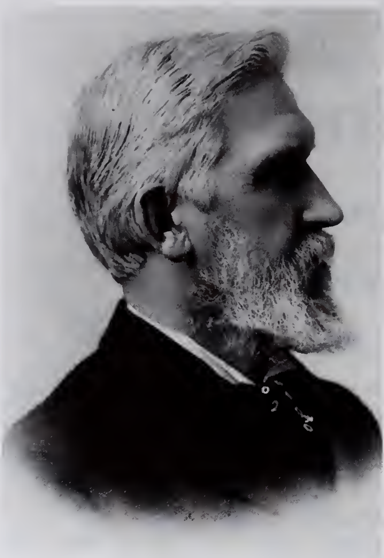


Photo credit: Oberlin College Archives, Oberlin, Ohio

Elisha Gray

Telautograph

Patent No. 461,470

Born August 2, 1835
Died January 21, 1901

Inducted in 2007

Elisha Gray invented numerous improvements in the telegraph and telephone industries, including the telautograph, a forerunner of the modern day fax machine.

Born in Barnesville, Ohio, Gray had developed an interest in telegraphic communication from an early age and built a working prototype at age ten, less than a year after the first telegraph line was erected. After attending Oberlin College for two years, Gray established himself as an electrician while simultaneously designing and inventing various telegraphic devices, including a telegraphic relay in 1867 that won him patronage from Western Union. Gray subsequently became a founder of the Western Electric Manufacturing Company, which manufactured telegraphic instruments. In 1875, Gray sold his share of Western Electric to become a full time inventor.

Pursuing his goals of advancing telegraph and telephone technology, Gray became engaged in a race with Alexander Graham Bell to invent a telephonic transmitting device. While there was controversy and years of litigation, Gray continued to make various improvements in telephonic communication. He pioneered the telephone call box, speaking telephones, and the telautograph, which transmitted copies of handwritten documents.

Photo credit: Crown Holding, Inc.

William Painter

Bottle-Sealing Device

Patent No. 468,226

Born November 20, 1838
Died July 15, 1906

Inducted in 2006

William Painter invented the crown bottle cap in 1892. Crown caps, both pry-offs and twist-offs, are still used today.

Although bottled carbonated beverages were already popular by the 1880s, there was a constant problem with stoppers and bottle caps. They lacked reliability because they did not seal the beverage sufficiently, causing liquids and carbonated gases to leak.

Determined to prevent beverages from being ruined, Painter invented the Crown Cork bottle cap. The Crown Cork had a corrugated-flange edge and was lined with a thin cork disc and a special paper backing to seal the bottle and prevent contact between the metal cap and the drink. It was simple, economical to produce, and leakproof. After working with bottling manufacturers to develop a universal neck, Painter invented and patented all the machinery needed to manufacture the caps. He successfully launched the Crown Cork and Seal Company in 1892 to manufacture and market the cap.

As technology has advanced, the crown cap has been refined. The cork disc was replaced with PVC material, the cap's teeth were reduced from 24 to 21, and the skirt's height was shortened. The crown cap is the universal cap used for carbonated beverages in glass bottles today.

Born in Triadelphia, Maryland, Painter earned 85 patents in his lifetime.

Jesse Wilford Reno

Endless Conveyor or Elevator

Patent No. 470,918

Born 1861
Died 1947

Inducted in 2007

Jesse Reno is one of several individuals credited with the beginnings of the modern escalator.

Born in Ft. Leavenworth, Kansas, Reno obtained degrees in mining and metallurgical engineering from Lehigh University. In 1892, he invented a conveyor belt set at an incline of 25 degrees. The planks of the conveyor belt were metal with a serrated surface, much like the steps of today's escalator. The design allowed for a smooth transition between the belt and the landings by combining serrated planks with a set of comb-like teeth at the top and bottom landings. A handrail that moved with the conveyor belt provided the passenger with an added sense of security. Reno also suggested a use for his device that is now standard: using one escalator to transport people up and another to bring people back down.

Reno's design was displayed as a ride at Coney Island's Iron Pier in 1896, transporting its passengers to a height of seven feet. During the two weeks that it was showcased, about seventy-five thousand people are believed to have ridden it.

In 1902, Reno founded Reno Electric Stairways and Conveyors, Ltd. and his invention was installed in various locations. Early in the next decade, the Otis Elevator Company purchased Reno's venture and utilized its patent.

Photo credit: Post Street Archives

Herbert Henry Dow

Process of Extracting Bromine

Patent No. RE 11,232

Born February 26, 1866
Died October 16, 1930

Inducted in 1983

Herbert Henry Dow, founder of the Dow Chemical Company, was one of the creators of the modern American chemical industry. His inventions included steam and internal combustion engines, automatic furnace controls, and water seals, but most of his inventions were chemical in nature. Born in Belleville in Ontario, Canada, Dow received his formal training from Case School of Applied Science and graduated in 1888 with a B.S. degree. He entered the rudimentary chemical industry of the 1890s by inventing an entirely new method of extracting bromine from the prehistoric brine trapped underground at Midland, Michigan.

He is best known for his work in halogen chemistry, particularly the production of bromine and chlorine. Most of his chemical patents were for truly "pioneer" inventions, and the remainder were practical improvements which took halogen science from theory to reality, creating employment and an environment which encouraged a healthy combination of basic and applied research. The combined effect of his inventions was to improve the quality of life for millions of people around the world.

Dow was a public-spirited citizen, serving on boards of public works and education for many years. His favorite saying was, "If we can't do it better than the others, why do it?"

Photo credit: Naval Historical Center

John Phillip Holland

Submergible Torpedo Boat

Patent No. 472,670

Born February 29, 1840
Died August 12, 1914

Inducted in 2007

John Phillip Holland was known for his contributions to the invention of submarines and submarine components, many of which found their way into the designs used by the United States Navy.

Born in Liscannor, Ireland, Holland moved to the U.S. to build submergible boats, developing several functional submarine prototypes during the latter half of the 19th century. His most significant advancements included the *Holland I* in 1878, a two-and-a half meter, one-person submersible and the *Fenian Ram*, a thirty-one foot long vessel. Founding the John P. Holland Torpedo Boat Company, he designed and manufactured submersible prototypes that sparked the interest of the U.S. Navy. He would win eventual success with an improved *Holland I* design, a 53.3 foot long, six-person submersible that could remain under water for forty hours.

The *Holland* was launched in 1897, and in 1900, the U.S. Navy purchased the submarine for $150,000. This submarine design would become the model for the Navy's fleet of submersibles for the next several decades.

In addition to obtaining patents for submarines, Holland also received patents for various supplementary apparatus, such as a screw propeller, several guns, and a visual indicator.

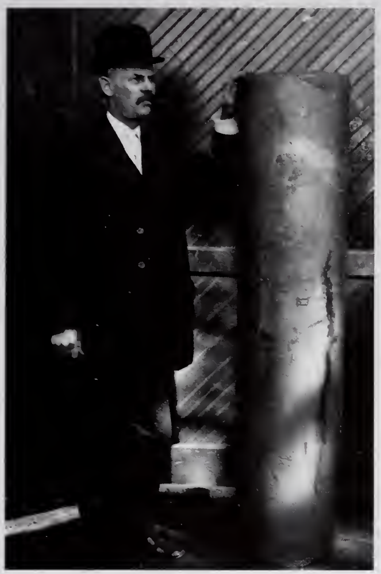


Photo credit: Courtesy of Daniel Martin Dumych

Edward Goodrich Acheson

Production of Artificial Crystalline Carbonaceous Materials; Article of Carborundum and Process of the Manufacture Thereof

Patent Nos. 492,767; 615,648

Born March 9, 1856
Died July 6, 1931

Inducted in 1997

Edward Acheson's discovery of carborundum, a highly effective abrasive used in manufacturing, was an important influence in advancing the industrial era. Born in Washington, Pennsylvania, Acheson worked with Thomas Edison before establishing his own lab. There, he began experimenting in search of a good industrial abrasive. When he tried intensely heating a mixture of carbon and clay, he found that the mixture yielded silicon carbide, or carborundum. In 1926, the U.S. Patent Office named carborundum as one of the 22 patents most responsible for the industrial age.

Not long after that, it was noted that without carborundum, the mass production manufacturing of precision-ground, interchangeable metal parts would be practically impossible. In the mid 1890s, Acheson discovered that overheating carborundum produced almost pure graphite. This graphite was another major discovery for him, and it became extremely valuable and helpful as a lubricant.

Acheson was key in successfully establishing at least five industrial corporations dependent on electrothermal processes. He received a total of 70 patents relating to abrasives, graphite products, reduction of oxides, and refractories.

Wilhelm Maybach

Apparatus for Cooling Liquids Employed in Motors and Compressors; Explosion and Combustion Motor

Patent Nos. 499,302; 668,111

Born February 9, 1846
Died December 29, 1929

Inducted in 2007

As an industrialist and designer of automobiles and engines, Wilhelm Maybach enjoyed an illustrious career and a profitable working relationship with his German industrialist colleague, Gottlieb Daimler.

Born in Heilbronn, Germany, Maybach became an engine designer for Daimler at the age of nineteen. He eventually became Daimler's assistant, and the two formed a friendship that was to last until Daimler's death.

Daimler and Maybach's collaboration resulted in a number of motor vehicle improvements, including some of the first self-propelled vehicles produced under Daimler in 1885 and 1886. Maybach's V-twin engine, developed in 1889, represented a milestone that was recognized by other automobile manufacturers, such as France's Peugeot, which bought its production rights. Daimler and Maybach founded the Daimler Motor Company in 1890 to manufacture internal combustion engines. Maybach would subsequently leave the company in 1907 and produce engines for zeppelins as well as automobiles, such as the Maybach W3 limousine in 1921.

During his career, Maybach pioneered additional innovations, such as the gearwheel transmission, the honeycomb radiator, and a hydrocarbon engine.

Photo credit: Photograph provided courtesy of Lehigh University

Eckley B. Coxe

Traveling-Grate Furnace

Patent No. 510,565

Born June 4, 1839
Died May 13, 1895

Inducted in 2006

Eckley Coxe invented a mechanical stoker that allowed small pieces of coal, which had previously been discarded as waste, to be burned as fuel. His device also eliminated the backbreaking work of manual stoking and provided greater thermal efficiency.

Born in Philadelphia, Coxe was raised and educated to develop his family's extensive holdings of coal-rich land. A respected engineer, he created a large shop complex and one of the finest technical libraries in America near the Coxe mines in Drifton, Pennsylvania. There, he designed machinery to modernize the mining, processing, and burning of anthracite coal.

Coxe's radical new furnace comprised a traveling grate that moved at a rate that allowed small chunks of anthracite coal to ignite, burn completely without clinkering, and cool before being deposited in a waste pile.
The inventor was granted over 100 patents, many of which related to his automatic stoker.

Coxe co-founded the American Institute of Mining Engineers in 1871 to encourage scientific approaches to improving coal engineering. To further the welfare of his workers, he established one of the first employee benefit programs, built a private hospital for his miner-employees, and founded a night school at which miners could learn math, science, and English.

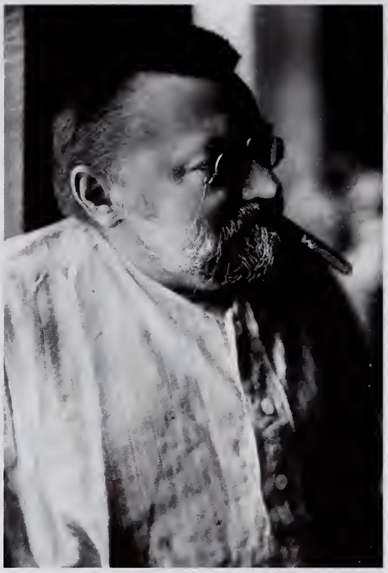


Photo credit: Courtesy of the Grems Doolittle Library, Schenectady County Historical Society

Charles Proteus Steinmetz

System of Distribution By Alternating Currents

Patent No. 533,244

Born April 9, 1865
Died October 26, 1923

Inducted in 1977

Without Charles Steinmetz's theories of alternating current, the expansion of the electric power industry in the United States in the early 20th century would have been greatly delayed. Born in Breslau, Germany, Steinmetz studied at the University of Breslau, where he devoured books on every subject. In 1888 he wrote an outspoken editorial criticizing the government, however, and was forced to flee Germany to escape arrest. He went first to Zurich, then, in 1889 arrived in the United States.

In 1893, Steinmetz joined the newly organized General Electric Company in Schenectady, New York, serving as consulting engineer until his death. Steinmetz's first important research was on hysteresis, by which power is lost because of magnetic resistance. This research led him directly to a study of alternating current, which could eliminate hysteresis loss in motors.

During the next 20 years he prepared a series of masterful papers and volumes which reduced the theory of alternating current to order. Steinmetz's last research was on lightning, which threatened to disrupt the new AC power lines. Here again he made fundamental contributions.

Photo credit: Courtesy of Presstek

Albert B. Dick

Stencil-Printing Machine

Patent No. 538,663

Born April 16, 1856
Died August 15, 1934

Inducted in 2011

Albert Dick, who founded the A.B. Dick Company in 1883, invented the mimeograph stencil in 1884 based on an early design by Thomas Edison. Dick licensed several of Edison's printing patents which covered an electric pen used for making the stencil and the flatbed duplicating process. Dick experimented with a file and waxed wrapping paper, and he invented his own duplicating process. In 1887 he coined the word "mimeograph" to describe this process.

The mimeograph, also referred to as a stencil duplicator, was a duplicating machine that used a stencil consisting of a coated fiber sheet through which ink was pressed. Within the same year, the company released their first commercial product, the Model "0" Flatbed duplicator. The invention initiated the era of modern printed communications; formerly, documents were reproduced by writing by hand.

The first of these primitive copiers was hand-cranked, and eventually larger, more automated models were introduced. In 1918, the company established the "Ditto" trademark. Mimeograph technology eventually lost out to the new copy methods pioneered by Haloid/Xerox; however, the company continued innovating and by the mid-1970s annual sales approached $300 million.

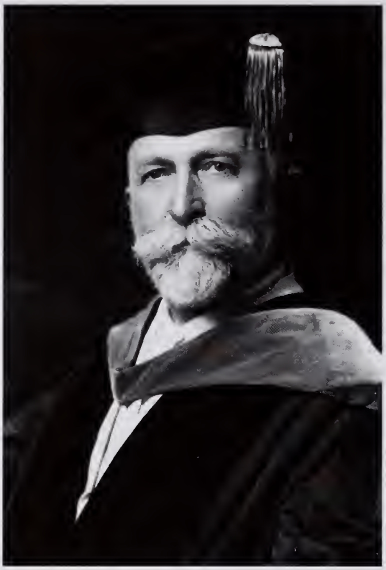


Photo credit: Courtesy of the Library of Congress

John H. Kellogg

Flaked Cereals and Process of Preparing Same

Patent No. 558,393

Born February 26, 1852
Died December 14, 1943

Inducted in 2006

John H. Kellogg invented Corn Flakes®, the first dry, flaked breakfast cereal. Corn Flakes became the most popular dry breakfast cereal in the world and transformed the typical American breakfast.

Kellogg was born in Tyrone Township, Michigan. He attended the University of Michigan Medical School and graduated from Bellvue Hospital Medical College. In 1876 he became superintendent of the Battle Creek Sanitarium in Battle Creek, Michigan. There, he promoted wellness through a healthy, vegetarian diet, and routinely experimented with new food products.

Kellogg was working with his brother Will on a new kind of wheat meal for patients at the sanitarium when the process that resulted in Corn Flakes was accidentally discovered. Rolling out wheat dough that had been forgotten overnight, the brothers discovered that instead of loaves of bread they got thin flakes. Kellogg's patients liked the new food, and he sold over 100,000 pounds of the cereal in the first year.

John Kellogg invented other popular food products, including peanut butter, granola, and a grain-based coffee substitute. He continued to run the sanitarium and to experiment with new foods, while Will left the hospital and founded the Kellogg Toasted Flake Company, the predecessor to today's Kellogg Company.

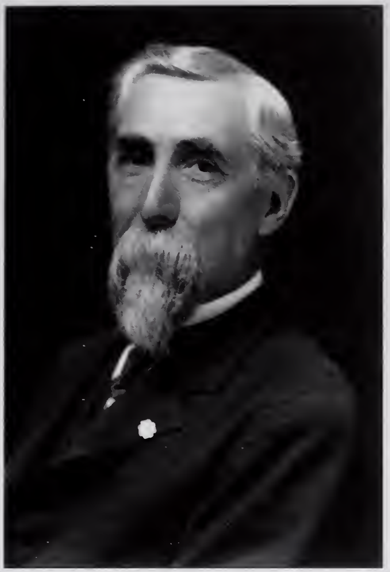


Photo credit: Courtesy of GM Media Archives

Henry M. Leland

Trimming Machine

Patent No. 569,789

Born February 16, 1843
Died March 26, 1932

Inducted in 2011

Henry M. Leland was an inventor, machinist, engineer, and automotive entrepreneur who not only founded two leading American automobile luxury brands, Cadillac and Lincoln, but also introduced to Detroit the concept of interchangeable parts for automobiles.

The basic techniques for making interchangeable parts were developed in 19th century New England. This concept was used by manufacturers who specialized in clocks, guns, and sewing machines, and Henry Leland played a prominent role in transferring this know-how from New England to the automotive industry. Leland applied his skill in manufacturing to the emerging motor industry as early as 1870 to Ransom E. Olds for use in his first Oldsmobiles. Leland fully entered the automobile business in 1902 when he joined forces with William Murphy and his partners to create a new company to market a luxury car built with precision interchangeable parts. Leland suggested they name the company Cadillac.

Leland sold Cadillac to General Motors in 1909 for $4.5 million, and later formed the Lincoln Motor Company. During WWI, Leland received a government contract to build the V12 Liberty Engine. The V8 engine used in the first Lincoln automobiles was influenced by the Liberty engine's design. Leland is also credited with inventing electric barber clippers and the Leland-Detroit Monorail.

Photo credit: U.S. Department of Interior. National Park Service. Thomas Edison National Historical Park.

Thomas J. Armat

Vitascope

Patent No. 580,749

Born October 25, 1866
Died September 30, 1948

Inducted in 2011

Thomas J. Armat was a pioneer of early cinema best known for the co-invention of the Edison Vitascope. His accomplishments include the development of motion picture projectors created in collaboration with fellow Bliss School of Electricity classmate Charles F. Jenkins.

Jenkins had already invented a device for viewing motion pictures which he called the Phantoscope, a variant on the Edison Kinetoscope. Modifying the Phantoscope, Armat and Jenkins were able to develop a movie projector which used a new kind of intermittent motion mechanism, often referred to as a "beater mechanism." This modified projector was also one of the first projectors to use the Latham loop, an extra loop of film used before the transport mechanism that reduced tension on the film and avoided breakage. Also used in this projector was sprocketed film that would allow each frame to stop briefly before the lens. Both of these features are retained in modern film projectors. In May 1895, Armat and Jenkins had developed a projecting version of the Phantoscope and applied for its patent. The next year, Armat contracted with Thomas Edison to have the invention manufactured under the name Vitascope.

In 1947, Armat was one of several representative movie pioneers who was awarded an Academy Award for his contributions to the film industry.

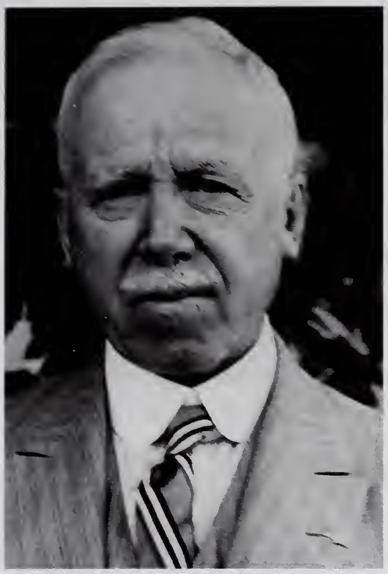


Photo credit: Special Collections, Cleveland State University Library

Alexander Winton

Explosive-Engine

Patent No. 582,108

Born June 20, 1860
Died June 21, 1932

Inducted in 2006

One of the most skillful and insightful automobile pioneers of his time, Alexander Winton was one of the first Americans to build automobiles for regular sale to the public, predating Henry Ford's car by more than five years.

Winton was born in Grangemouth, Scotland. In the 1890s, he began developing a horseless carriage, an idea originating from the European Industrial Revolution. After inventing a gasoline-motored bicycle, Winton broadened his idea to a car. By 1896, his car had a two-cylinder vertical engine with friction clutch, electric ignition, carburetor, regulator to control engine speed, engine starter, and pneumatic tires. Initial success led Winton to establish the Winton Motor Carriage Company to build an improved, dependable model. Winton sold his first car in 1898 for $1,000, the first sale of a gasoline automobile in America.

Winton's contributions to the growth of the American car industry extended to external and internal brakes on the same brake drum, which became the standard. With his company a success, Winton turned to improving the diesel engine. In 1913, the company produced the first American-made diesel engine. Winton's diesel factory was purchased by General Motors in 1930 and produced railroad engines until 1962.

Winton held more than 100 patents in automobile design.

Photo credit: Courtesy of The Smithsonian Institution

Guglielmo Marconi

Transmitting Electrical Signals

Patent No. 586,193

Born April 25, 1874
Died July 20, 1937

Inducted in 1975

In 1895 Italian inventor Guglielmo Marconi built the equipment and transmitted electrical signals through the air from one end of his house to the other, and then from the house to the garden. These experiments were, in effect, the dawn of practical wireless telegraphy or radio.

Marconi was born in Bologna, Italy. His father was Italian, his mother Irish. He was educated first in Bologna and later in Florence. Then he went to the technical school in Leghorn, where he studied physics.

Following the successes of his experiments at home, Marconi became obsessed with the idea of sending messages across the Atlantic. He built a transmitter, 100 times more powerful than any previous station, at Poldhu, on the southwest tip of England, and in November 1901 installed a receiving station at St. John's Newfoundland. On December 12, 1901, he received signals from across the ocean. News of this achievement spread around the world, and he was acclaimed by outstanding scientists, including Thomas Edison.

Marconi received many honors, including the Nobel Prize for Physics in 1909. He was sent as a delegate to the Peace Conference in Paris in 1919, in which capacity he signed the peace treaties with Austria and Bulgaria.

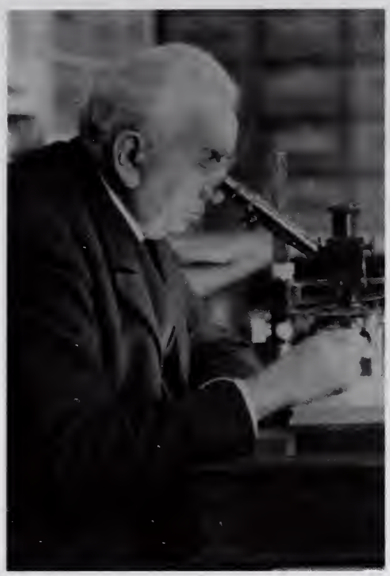


Photo credit: George Eastman House

Auguste-Marie Lumière

Picture-Exhibitor

Patent No. 591,858

Born October 19, 1862
Died 1954

Inducted in 2007

Auguste-Marie and Louis Lumière, inventors and experts in the realm of photography, designed a camera and projector apparatus known as the Cinématographe, the forerunner to contemporary cinematic projection. The Lumières gained additional distinction for creating the first efficient color-photography process, known as the Autochrome plate, and are recognized as the founders of modern cinema.

The Cinématographe was different from other projectors at the time. Its portability, and the hand-operated crank that advanced the film, allowed the Lumières to record footage outside a contained environment.

The Cinématographe was initially shown to close peers within the industry, but it publicly debuted in Paris on December 28, 1895, featuring the 45-second long film *La Sortie de l'usine Lumière à Lyon*. Within four months, the Lumières opened theaters in New York, Berlin, London, and Brussels.

Auguste-Marie was born in Besançon, France and studied at the University of Bern. By the turn of the 20th century, the brothers enjoyed worldwide renown; their small group of titles had expanded to over 700, and they were able to send cameramen all over the globe in search of interesting subjects to film.

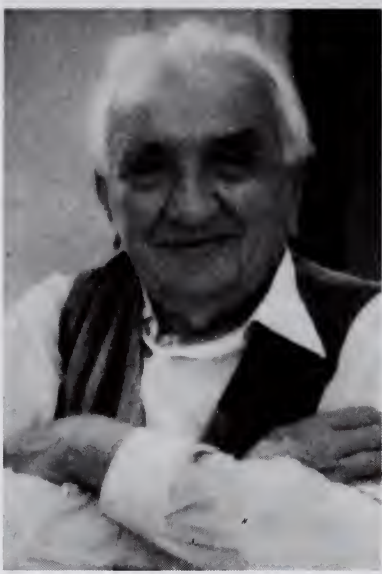


Photo credit: Courtesy of the Library of Congress [LC-USZ62-106402]

Louis Lumière

Picture-Exhibitor

Patent No. 591,858

Born October 5, 1864
Died June 6, 1948

Inducted in 2007

Louis and Auguste-Marie Lumière, innovators in photography, designed a camera and projector apparatus called the Cinématographe, which became the basis for contemporary cinematic projection.

Patented in 1895, the Cinématographe was unlike its predecessor, Thomas Edison's Kinetoscope. Movable and hand-operated with a claw foot to advance the film, the new camera allowed the Lumières to record footage outside a contained environment. It enabled users to record, develop, and project motion pictures with ease.

Initially reserved for specialists, the Cinématographe held its public debut in Paris on December 28, 1895, featuring the 45-second long film *La Sortie de l'usine Lumière à Lyon*, heralding the birth of cinema. During the following year, the Lumières opened theaters in the U.S. and Eastern Europe.

Born in Besançon, France, Louis studied at École Technique, La Martinière. The Lumières' work had an immediate effect on popular culture. Their early films were the first documentaries filmed, and later works served as the precursor to cinematic slapstick comedy. They also created the first newsreel, which was of the French Photographic Society Conference. By 1897, they enjoyed worldwide fame and their number of films had expanded to over 700.

Photo credit: Courtesy of the Birmingham Historical Society

Andrew J. Beard

Car-Coupling

Patent No. 594,059

Born 1849
Died 1921

Inducted in 2006

Andrew Jackson Beard invented the first automatic railroad car coupler, which dramatically reduced serious injuries to railroad workers. Beard's invention was a forerunner of automatic couplers used today.

Beard was born a slave in Jefferson County, Alabama. Emancipated at age fifteen, he became a farmer and then built and ran a flourmill. Despite having received no formal education, Beard invented several types of plows, patented two of them, and successfully invested profits from the inventions in real estate. He went on to invent a steam-driven rotary engine before patenting his most important device, the automatic railroad car coupler, in 1897.

Prior to Beard's invention, workers braced themselves between railroad cars and coupled them manually. Few who worked at manual car coupling avoided the loss of at least a finger; many lost a hand or limb, or were crushed between cars. Beard's "Jenny Coupler" eliminated human involvement between the cars by engaging horizontal jaws that automatically locked together when two cars bumped into each other.

The same year that Beard patented his coupler, Congress enacted the Federal Safety Appliance Act. The Act made it unlawful to operate railroad cars that were not equipped with automatic couplers.

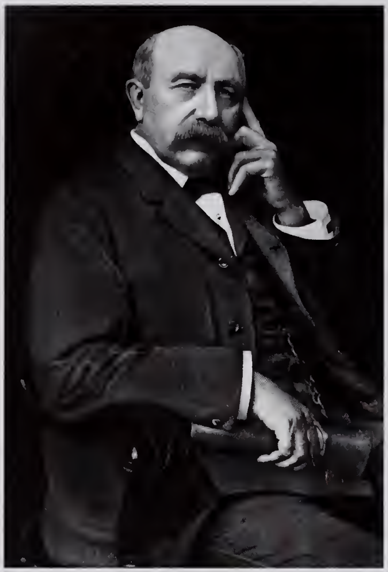


Photo credit: The Timken Company

Henry Timken

Roller Bearing for Vehicles; Roller Bearing

Patent Nos. 606,635; 606,636

Born August 16, 1831
Died March 16, 1909

Inducted in 1998

Henry Timken invented the Timken® tapered roller bearing. He found that conventional bearings of the 19th century worked well at reducing friction, but ran into problems when the wheels had to bear heavy loads from the sides, as when vehicles turn. So, in 1895, with the help of his two sons and a nephew, he began experiments to make a better bearing. He developed Timken tapered roller bearings to bear the heavy side loads.

Born in Bremen, Germany, Timken and his family immigrated to the U.S. when he was seven, settling in Missouri. As a teenager, Timken became an apprentice to a leading carriage and wagon maker. Eventually, he established his own carriage factory in St. Louis. In 1877, Timken converted the factory to make the "Timken Buggy Spring" which was in world demand.

In 1898, he received two roller bearing patents, and in 1899, he established The Timken Roller Bearing Axle Company in a corner of his factory. The company grew so quickly that Timken decided to build a plant and relocate to Canton, Ohio to be near the emerging automotive industry.

In the 1920s, The Timken Company was making 90 percent of the country's bearings. By the early 1990s, they supplied nearly a third of the world's tapered roller bearings.

Photo credit: Courtesy MAN Historical Archives

Rudolf Diesel

Internal-Combustion Engine

Patent No. 608,845

Born March 18, 1858
Died September 29, 1913

Inducted in 1976

Best known for his pressure-ignited heat engine, French-born Rudolf Diesel was also a thermal engineer, a connoisseur of the arts, a linguist, and a social theorist. Diesel's inventions have three points in common: they relate to heat transference by natural physical processes or laws; they involve markedly creative mechanical design; and they were initially motivated by his concept of sociological needs. Diesel originally conceived the diesel engine to enable independent craftsmen and artisans to better endure the powered competition of large industries that then virtually monopolized the predominant power source–the oversized and expensive steam engine.

In 1885 Diesel set up his first shop-laboratory in Paris and began his 13-year ordeal of creating his distinctive engine. At Augsburg, on August 10, 1893, Diesel's prime model, a single 10-foot iron cylinder with a flywheel at its base, ran on its own power for the first time. Diesel made improvements and in 1896 demonstrated another model with the spectacular, if theoretical, mechanical efficiency of 75.6 percent, in contrast to steam engine efficiency of 10 percent or less.

By 1898, Diesel was a millionaire. His engines were used to power pipelines, electric and water plants, automobiles and trucks, marine craft, and soon after were used in applications including mines, oil fields, factories, and transoceanic shipping.

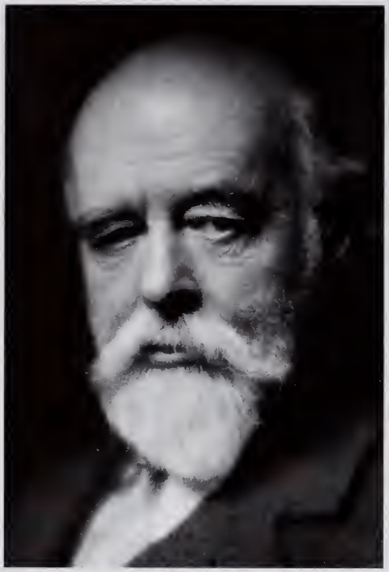


Photo credit: Courtesy of the Library of Congress [LC-USZ62-101784]

Oliver Joseph Lodge

Electric Telegraphy

Patent No. 609,154

Born June 12, 1851
Died August 22, 1940

Inducted in 2007

Physicist Oliver Lodge made several important technological contributions, most notably his advancement of wireless telegraphy.

Lodge's invention of wireless telegraphy stemmed from his research into electromagnetic waves, and his patent of 1898 outlined a device that could "transmit messages across space" between people in various locations. He postulated that different stations could send and receive signals at different frequencies, avoiding any interference between the stations. His device achieved this by producing and transmitting a series of electric oscillations and pulses—excited at a certain frequency— from a sending station. The receiving station would be outfitted with an electric relay that could capture the oscillation at its particular frequency.

He also advanced the motor vehicle industry by designing the Lodge Igniter, an electric spark ignition for engines, an early form of spark plugs. Lodge's sons founded a company in the early 20th century to produce and market the Lodge Igniter.

Born in Stokes-on-Trent, England, Lodge earned his Bachelor of Science degree from the University of London in 1875. He was knighted by King Edward VII in 1902.

Photo credit: Courtesy of Library of Congress Prints and Photographs Division; [LC-DIG-ggbain-15525]

Hannibal Goodwin

Photographic Pellicle and Process of Producing Same

Patent No. 610,861

Born April 21, 1822
Died December 31, 1900

Inducted in 2011

In the late 1870s, Hannibal Goodwin developed a method for making transparent, flexible roll film out of a nitrocellulose film base. Goodwin, an Episcopal priest and amateur photographer, was inspired to invent this film when he was unable to find suitable Bible pictures for use in his Sunday-school classes. Initially, he decided to make his own glass-plate photographs, but soon found that glass-plate photography was a cumbersome, multi-step process. Hoping that a new camera might be the answer, Goodwin also experimented with George Eastman's Kodak camera, but was dissatisfied that the camera had to be sent back to the factory for processing.

Goodwin made his flexible photographic film by dissolving nitrocellulose in nitrobenzole and then diluting the thick mixture with alcohol. He poured the mixture onto glass, and when the nitrobenzole and alcohol evaporated, he had a film that could be coated with emulsion and used for taking pictures.

He applied for a patent in 1887 for his roll film at the same time Eastman Kodak was experimenting with flexible film. The Patent Office declared an interference between Goodwin and Kodak, and Goodwin won the case. Goodwin then sued Kodak for patent infringement, and some years after Goodwin's death, his estate won a $5 million settlement.

Photo credit: Prade, Marcel Ponts et viadues au XIXème siècle (1988)

François Hennebique

Construction of Joists, Girders, and the Like

Patent No. 611,907

Born April 26, 1842
Died March 7, 1921

Inducted in 2011

François Hennebique devised the pioneering technique of construction with reinforced concrete. Hennebique worked first as a stonemason, with a particular interest in restoring gothic cathedrals, and later became an engineer and self-educated builder. He patented his revolutionary reinforced-concrete construction system in 1892. He started with reinforced-concrete floor slabs, concrete slabs with steel bars in the bottom, and advanced to a total building system using structural beams of concrete reinforced with stirrups and longitudinal bars designed to withstand the tensile forces against which ordinary concrete was weak.

He first developed his reinforced concrete system on a house project in Belgium in 1879 where he used concrete as a fireproof protection for wrought iron beams. In 1894, Hennebique built the first reinforced concrete bridge in Wiggen, Switzerland. His business developed rapidly, expanding from five employees in Brussels in 1896, to twenty-five two years later when he moved to Paris. In addition, he had a rapidly expanding network of firms acting as agents for his system. Hennebique's idea of strengthening concrete using iron and steel bars was the forerunner to the widespread modern reinforced-concrete method used in construction today.

Photo credit: Courtesy of Otis Elevator Company Historic Archives

Charles D. Seeberger

Elevator

Patent No. 617,778

Born 1857
Died September 12, 1931

Inducted in 2007

Charles Seeberger was an inventor whose patented idea contributed to the development of the modern escalator.

Born in Oscaloosa, Iowa and employed by the Otis Elevator Company, Seeberger is most commonly attributed with coining the term escalator, a combination of the Latin *scala* (steps) with "elevator." Seeberger's invention consisted of risers attached to a series of levers and wheels which traveled in tracks. As the slats were pulled along the tracks, the movement of the wheels and lever arms ensured that the steps remained horizontal throughout the entire operation. In addition, an elastic rubber strip placed underneath the slats remained in contact with the adjacent riser. The rubber strip served as a safety device to seal any gaps between steps.

In connection with the Otis Elevator Company, Seeberger built the first commercially produced escalator based on his design in the Otis factory in 1899, and put such a model on display at an exhibition in Paris in 1900 where it won an award. In 1910, Seeberger sold his design outright to Otis. The Otis Elevator Company began to manufacture escalators with many features that are still in existence today.

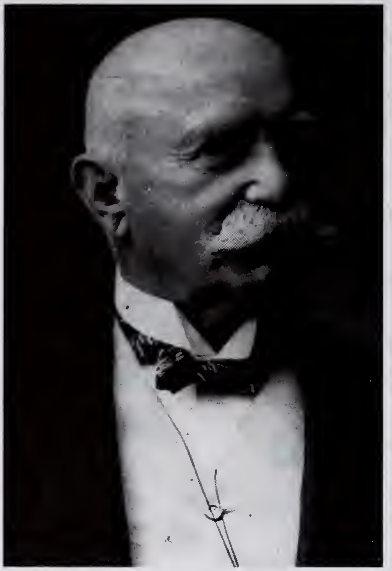


Photo credit: Courtesy of the Library of Congress

Ferdinand von Zeppelin

Navigable Balloon

Patent No. 621,195

Born July 8, 1838
Died March 8, 1917

Inducted in 2006

Ferdinand von Zeppelin conceived and developed the first rigid dirigible, a lighter-than-air vehicle, known as the zeppelin.

Born in Konstantz, Germany, Zeppelin studied at the University of Tübingen before entering the Prussian Army in 1858. After retiring from the army with the rank of brigadier general, he devoted himself to the design and construction of airships. His first airship was built in 1900 with a rigid frame, serving as the prototype for many subsequent models. The zeppelin airship consisted of a row of 17 gas cells individually covered in rubberized cloth. It was 420 feet long and 38 feet in diameter with a hydrogen-gas capacity reaching 399,000 cubic feet. Steered by forward and aft rudders, two 15-horsepower internal combustion engines powered the aluminum ship.

By 1910, Zeppelin had created the first commercial air service for passengers using his airship, which traveled more than 40 miles per hour. The zeppelin was extremely useful during World War I, providing additional aviation presence for patrols and bombing runs. After the war, the zeppelin was widely used in commercial flights. Although safety concerns eventually led to decreased popularity, the zeppelin was one of the first aircraft to provide commercial transports and establish principles of lighter-than-air craft.

Photo credit: Image in Public Domain

Walther H. Nernst

Electrical Glow-Light

Patent No. 623,811

Born June 25, 1864
Died November 18, 1941

Inducted in 2011

Walther Nernst developed a new form of electric lighting, the Nernst lamp, that was a significant improvement over the carbon-filament lamp. In Nernst's new electric lamp, he replaced the carbon filament that Edison had been using with an incandescent ceramic rod made of zirconium oxide-yttrium oxide. Because the rod would not further oxidize when exposed to air, there was no need to enclose it within a vacuum or noble gas environment. The burners in the Nernst lamps could operate exposed to the air and were only enclosed in glass to isolate the hot incandescent emitter from its environment.

Nernst lamps were about twice as efficient as carbon filament lamps and emitted a more natural looking light. Nernst sold the patent to George Westinghouse who founded the Nernst Lamp Company. Due to the great success of the Nernst lamps, General Electric was obliged to undertake a fast program to develop an alternative to the Nernst Lamp. In 1906, GE introduced incandescent lamps with tungsten filaments and recaptured much of the lamp market.

Nernst went on to study osmotic pressure and electrochemistry and in 1905 established what he referred to as his "New Heat Theorem" later known as the Third Law of Thermodynamics. In 1920, he was a recipient of the Nobel Prize in Chemistry.

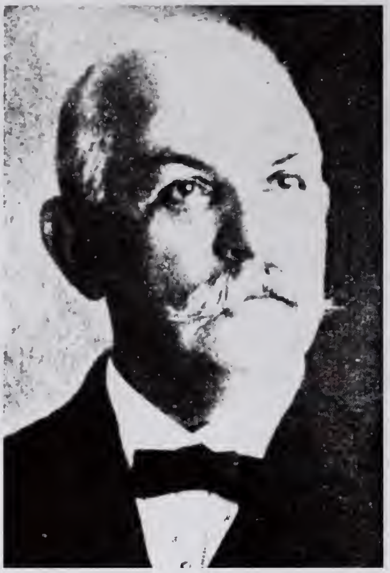


Photo credit: T. Van Kannel, The Inventor: His Biography and Journal, edited by Harvey E. Van Kannel and Joanne Fox Marshall, 1988

Theophilus Van Kannel

Revolving Door Structure

Patent No. 641,563

Born 1841
Died December 24, 1919

Inducted in 2007

In 1888, Theophilus Van Kannel invented the revolving door, a design that characterized the entrance of modern skyscrapers.

The revolving door helped alleviate several problems associated with conventional doors. It served as an airlock, preventing the rapid influx of cold air into warm buildings on chilly, windy days. The revolving door also kept out street noises and fumes. The door proved particularly useful in skyscrapers, where the pressure differences created by a large column of warm air inside the building and the outside cold air made conventional doors difficult to open or close. Architects also liked the doors, since moving from the small, enclosed space of a revolving door into a lobby made the space seem large and majestic.

In 1889, Van Kannel was awarded the John Scott Medal by the City of Philadelphia for the usefulness of his invention to society. Van Kannel established his own company, the Van Kannel Revolving Door Company, to make and market his designs. He continued to work to improve the revolving door, but he also experimented with other inventions. In 1907, International Steel bought Van Kannel's revolving door business, and it survives today as the International Revolving Door Company.

Photo credit: Bayer AG

Felix Hoffmann

Acetyl Salicylic Acid

Patent No. 644,077

Born January 21, 1868
Died February 8, 1946

Inducted in 2002

Felix Hoffmann first made acetylsalicylic acid, better known today as aspirin, to ease his father's arthritis. However, aspirin's history begins long before Hoffmann's work with it while he was a chemist at Bayer.

Hippocrates realized that juice from willow tree bark killed pain. Scientists in the 19th century realized it was the salicylic acid in the willow that made the painkiller work, but it was hard on stomachs and had to be buffered. In 1899, Hoffmann rediscovered an old formula from a French chemist, and he spent time on developing and testing aspirin to promote its use.

More than a cure for headaches and minor pain, aspirin has been clinically proven to work wonders for many conditions. People at risk of heart attack are advised to take an aspirin a day, and aspirin is used to prevent and treat stroke. Aspirin is also thought to be a potent drug for cancer, heart disease, Alzheimer's, stroke, infertility, herpes, and blindness.

Studies have shown that long-term aspirin taking can reduce the risk of death from colon cancer by over 40%. Today, over 70 million pounds of aspirin are produced annually around the world, and Americans consume more than 15 billion tablets per year.

Photo credit: Firestone Family

Harvey S. Firestone

Vehicle-Tire

Patent No. 646,274

Born December 20, 1868
Died February 7, 1938

Inducted in 2006

Harvey Firestone's extensive contributions to the tire industry allowed him to create a company that served as the vanguard of innovation in the rubber industry during the early twentieth century.

After working in the rubber industry creating bicycle tires, Firestone founded the Firestone Tire & Rubber Company in 1900 to develop tires for automobiles. He saw the advantages of the pneumatic tire, as compared to the solid tire, and made several improvements. In 1905, Henry Ford discovered these advanced tires and immediately installed them on Ford Motor Company cars. Because of this relationship, many breakthroughs in the tire industry came from Firestone over the next thirty years, including a dismountable rim, the balloon tire, the first low-pressure truck tire, and the first rayon-cord tire.

In the 1950s and 1960s, the Firestone Tire & Rubber Company continued to innovate in the rubber industry with improved racing tires and radial tires. Firestone also was responsible for creating a temporary spare tire that is commonly used today.

Born in Columbiana, Ohio, Firestone is labeled as one of the top ten businessmen in American history. He has been inducted into the National Business and Automotive Halls of Fame.

Photo credit: The Western Reserve Historical Society, Cleveland, Ohio

George H. Hulett

Apparatus for Handling Ore

Patent No. 652,313

Born September 26, 1846
Died January 17, 1923

Inducted in 2006

George Hulett invented the automatic unloading machine that revolutionized ore shipping and advanced the economies and industries of Great Lakes port cities. Hulett's unloader eliminated the labor-intensive process of emptying ships' holds with shovels, buckets, hoists, and cables.

Hulett was born in the Lake Erie port city of Conneaut, Ohio. After completing his schooling at age 18, he spent over twenty-five years in the general retail and produce and commission businesses. In 1890, he began working for a manufacturer of machinery for the coal and ore industries. Eight years later, he invented the automatic loading and unloading machine.

Ten stories tall and weighing nearly 900 tons, Hulett's unloader was designed with a cantilevered arm and a giant bucket that could remove 17 tons of material from an ore carrier's hold in a single pass. With Hulett's invention, a small number of men could unload an ore ship in 13 hours, a substantial reduction from the full week previously spent by gangs of men with shovels. The cost of unloading ore dropped by more than two-thirds.

At one time, seventy-seven Hulett ore unloaders operated on the Great Lakes, with more in service at large ocean ports. Hulett's machines remained in use until near the end of the twentieth century.

Photo credit: Courtesy of Betty King

Rollin Henry White

Steam Generator; Controlled Differential

Patent Nos. 659,837; 1,253,319

Born July 11, 1872
Died September 10, 1962

Inducted in 2011

Rollin H. White contributed to the development of steam generation in early automobiles and trucks. He also designed and sold crawler tractors under the trade name Cletrac.

In 1898, White went to work at his father's factory in Cleveland, the White Sewing Machine Company, and the following year, invented his flash boiler to generate steam rapidly and safely in passenger vehicles. He also designed an engine with high and low pressure cylinders, for which he received a gold medal at the 1904 Louisiana Purchase Exposition. The White Steamers, produced by the spin-off White Motor Co., enjoyed great respect, winning competitions and setting speed records.

In 1912, White turned his talents to designing crawler tractors. He formed the Cleveland Motor Plow Company. Cletrac tractors were known as strong and maneuverable because of innovations like controlled differential steering (which is still in use by some crawler tractor manufacturers in the 21st century), an elevated drive sprocket, a unique bead chain track system, a double drive socket, and an oil pump to lubricate bottom rollers. A large number of Cletrac tractors have survived to the present day, many still in use on farms and construction projects.

White's last patent, his one hundredth, was issued in August 1933.

Photo credit: Courtesy of the Post & Tele Museum

Valdemar Poulsen

Method of Recording and Reproducing Sounds or Signals

Patent No. 661,619

Born November 23, 1869
Died July 23, 1942

Inducted in 2011

Danish engineer Valdemar Poulsen demonstrated magnetic recording in 1898. While working at the Copenhagen Telephone Company, Poulsen began experimenting with various electrical inventions, and he soon became interested in recording sound by magnetizing a steel wire. His experiment was successful, and Poulsen set about using the principle of magnetic recording to create a telephone answering machine. In 1898, Poulsen filed a patent in Denmark and other countries for the Telegraphone, the first device to use magnetic sound recording.

At the 1900 World's Fair in Paris, Poulsen recorded the voice of Emperor Franz Josef of Austria, which is regarded today as the oldest surviving magnetic audio. In 1927, American inventor J.A. O'Neill replaced the wire with a magnetically coated tape, but continued to use the basic technique developed by Poulsen.

Poulsen is also known for his work in improving wireless transmission. His honors include the Gold Medal from the Royal Danish Society of Science, the Danish government Medal of Merit, and Fellowship in the Swedish Institute for Engineering Research.

Photo credit: National Museum of American History

Charles Jenkins

Steroscopic Mutoscope

Patent No. 671,111

Born August 22, 1867
Died June 6, 1934

Inducted in 2011

Charles Jenkins was an innovator of early cinema and one of the first inventors of television, though he used mechanical rather than electronic technologies. Over the course of his career as an inventor, he secured hundreds of patents.

Jenkins started experimenting with movie film in 1891 and soon quit his job to focus on improving his movie projector, the Phantoscope. In 1894, Jenkins showed his parents, friends, and newsmen his "motion picture projecting box," presenting a short reel film which he had filmed himself. Jenkins' demonstration is regarded as one of the first times an audience watched a projected movie.

Jenkins attended the Bliss School of Electricity in Washington, D.C., where he met his fellow classmate Thomas Armat, and together they improved the design. They did a public screening at the Cotton States and International Exposition in Atlanta in 1895. Jenkins eventually sold his interest in the projector to Armat, who in turn sold it to Thomas Edison who marketed the projector under the name Vitascope. Jenkins, meanwhile, began work on television, founding the Jenkins Television Corporation in 1928. The company was acquired by the DeForest Radio Corporation, which later was purchased by RCA. RCA chose to focus on electronic television, rather than the mechanical means demonstrated by Jenkins.

Photo credit: The N.C. Division of Archives and History

Reginald A. Fessenden

Apparatus for Signaling By Electromagnetic Waves

Patent No. 706,747

Born October 6, 1866
Died July 22, 1932

Inducted in 2000

Reginald Fessenden is known for discovering amplitude modulation (AM) radio and explaining its scientific principles. With his heterodyne principle, he put into practice the idea of mixing two high frequency signals to carry the audible low frequency of the human voice.

Fessenden became fascinated with the idea of wireless telegraphy as a child when he saw Bell demonstrate his telephone. He wondered from that point on if he could transmit voice without using wires. In 1900 he did just that, transmitting his voice with his "wireless telephone." Six years later, history was made on Christmas Eve when Fessenden transmitted the first radio broadcast from Brant Rock Station, Massachusetts. Ships at sea heard a broadcast that included Fessenden playing "O Holy Night" on the violin and reading a passage from the Bible.

Born in East Bolton, Quebec, Canada, Fessenden was well-educated when he was young. When he was eighteen, he became headmaster at a school in Bermuda. His work subsequently took him back to the U.S. to work with Thomas Edison and to help George Westinghouse light the 1892 Columbian Exposition in Chicago. He then investigated wireless radio communication with the U.S. Weather Bureau. Fessenden held over 200 patents, including a version of microfilm and an early form of sonar.

Photo credit: Birmingham Public Library (BPL) Archives

Mary Anderson

Window-Cleaning Device

Patent No. 743,801

Born February 19, 1866
Died June 27, 1953

Inducted in 2011

While touring the city of New York in a trolley car on a snowy day in the early 1900s, Mary Anderson conceived her idea of a windshield wiper blade that could be operated from the inside by the trolley driver.

Anderson observed that streetcar drivers often had to open their windows in order to see during inclement weather, sometimes even stopping the streetcar to go outside to clear the window. Her idea consisted of a lever inside the vehicle that controlled a spring-loaded arm with a rubber blade. The lever, with a counterweight to keep the wiper in contact with the window, could move the blade across the windshield, removing rain or snow. With her 1903 patent, Anderson's invention proved to be the first windshield-clearing device to be effective.

As driving became more and more common, the windshield wiper was eventually adapted for automotive use. In 1922, Cadillac began installing the wiper as a piece of standard equipment on its cars.

During her lifetime, Anderson established herself as an entrepreneur. In addition to building and managing an apartment building in Birmingham, Alabama, she operated a cattle ranch and vineyard in Fresno, California.

Photo credit: Courtesy of the Library of Congress, Prints and Photographs Division; [LC-DIG-ggbain-20711]

Michael Pupin

Apparatus for Reducing Attenuation of Electrical Waves

Patent No. 761,995

Born October 4, 1858
Died March 12, 1935

Inducted in 2011

Michael Pupin, born Mihailo Pupin, was a Serbian physicist and physical chemist who devised a means of greatly extending the range of long-distance telephone communication by placing loading coils of wire at intervals along a transmitting wire. Pupin received a patent for his loading coils, and the importance of this innovation was made clear when the American rights to the patent were acquired by AT&T. Although AT&T had their own development in hand led by George Campbell, they purchased Pupin's patent to continue control of the technology needed to extend the range of long distance telephones.

Pupin studied at Columbia College in 1879 and later obtained his Ph.D. at the University of Berlin. He returned to Columbia University to become a lecturer of mathematical physics. There, Pupin's research pioneered carrier wave detection and current analysis. He was also among the first in America to follow up on Roentgen's discovery of x-rays in late 1895 and carried out one of the first medically oriented studies of the utility of x-rays.

In 1911 Pupin became a consul of the Kingdom of Serbia in New York. Following Pupin's "fourteen point" speech to Congress on January 18, 1918, President Woodrow Wilson was so inspired that he insisted on granting independence to Serbia and Montenegro, as well as autonomy for the peoples of the Austro-Hungarian monarchy.

Photo credit: Owens-Illinois Glass Company Records, MSS-200, Ward M. Canaday Center for Special Collections, University of Toledo

Michael J. Owens

Glass Shaping Machine

Patent No. 766,768

Born January 1, 1859
Died December 27, 1923

Inducted in 2007

Michael Owens played a major role in the history of glass product manufacturing with his automatic glass blowing machine.

Born in Mason County, West Virginia, Owens left school at the age of 10 for a glassware apprenticeship at J.H.Hobbs, Brockunier and Company in Wheeling. Within five years of his arrival, he became a master glassblower.

Moving to Toledo, Ohio, Owens worked for the Toledo Glass Factory, owned by glass manufacturing magnate Edwin Libbey. Eventually appointed as foreman and supervisor, Owens was responsible for constructing machines that could automate the production of glass containers. His glass bottle-making machine automated the entire process, from selecting the molten glass to blowing the glass into its final form. The machine produced glass bottles at a rate of 240 per minute, and in some cases, reduced labor costs by 80%.

Owens and Libbey entered into a partnership and the former's company was renamed the Owens Bottle Company in 1919. Ten years later, Owens and Libbey's establishment merged with the Illinois Glass Company to become the Owens-Illinois Glass Company.

Owens' invention of a glass bottle-making machine not only earned him fame but also contributed to Toledo's importance in the glass industry.

Photo credit: Courtesy of the Library of Congress [LC-USZ62-103167]

King Camp Gillette

Razor

Patent No. 775,134

Born January 5, 1855
Died July 9, 1932

Inducted in 2007

King Camp Gillette conceived the idea for and developed the disposable safety razor. Gillette's invention changed men's personal care, making it more convenient and safer to shave at home.

Gillette sought to create a product that could be used, thrown away, and bought again. At the time, razors were expensive and men typically used the same one for life; moreover, the blade had to be sharpened before each use. He struggled for years to find a way to make a blade inexpensively from a thin piece of metal that could be thrown away when it got dull. He worked with inventor William Nickerson, who helped improve Gillette's design and built a machine that would harden, hone, grind, and sharpen the blades.

The Gillette razor became standard issue for U.S. soldiers during World War I. By 1926, the Gillette Company produced 2.1 million blades each day, and men rarely went to barbers for a shave. Gillette's invention evolved over the years, and disposable razors became a familiar convenience in the daily lives of men and women alike.

Born in Fond du Lac, Wisconsin, Gillette established the American Safety Razor Company, forerunner to the Gillette Company, and sold its first razor in 1903. Although only 51 razor sets and 168 blades were sold that year, by 1904, sales had jumped to 90,000 razors and two million blades.

Photo credit: Carrier Corporation

Willis Haviland Carrier

Apparatus for Treating Air

Patent No. 808,897

Born November 26, 1876
Died October 9, 1950

Inducted in 1985

American engineer and inventor Willis Haviland Carrier developed the formulae and equipment that made air conditioning possible. Born near Angola in Western New York, Carrier attended Cornell University and graduated with an M.E. in 1901.

Only one year later his first installation of scientific air conditioning was in operation, controlling both temperature and humidity in a Brooklyn printing plant. The world's first spray type air conditioning equipment was Carrier's "Apparatus for Treating Air," which he correctly predicted would be used to enhance comfort as well as improve industrial processes and products. In 1911 Carrier disclosed his basic "Rational Psychrometric Formulae" to the American Society of Mechanical Engineers. The formulae still stands as the basis for all fundamental calculations in the air conditioning industry.

His development of the first safe, low pressure centrifugal refrigeration machine using nontoxic, nonflammable refrigerant marked the beginning of the era of comfort cooling. Carrier's early work in developing centrifugal refrigeration machines led to new safe refrigerants for which he also received several patents.

By controlling humidity as well as temperature, he invented air conditioning as we know it today. Carrier and several other engineers formed the Carrier Engineering Corporation in 1915 with capital of $35,000.

Photo source: History of Dentistry, by Walter Hoffmann – Axthelm, 1981

Alfred Einhorn

Alkamin Esters of Para-Aminobenzoic Acid

Patent No. 812,554

Born February 27, 1856
Died 1917

Inducted in 2007

German chemist Alfred Einhorn invented the widely recognized dental anesthetic Novocain. With his advancement, he ushered in a new era of safer, more reliable anesthetics.

Before the discovery of Novocain, cocaine was the most commonly used local anesthetic. In addition to being highly addictive, cocaine contained a level of toxicity that caused concern in the medical profession. Many individuals— including Einhorn, who started his work in this field in 1898— researched anesthetics that could provide an alternative to cocaine. In 1904, after years of trials and experiments, Einhorn reached a breakthrough with the substance he first named procaine, later to be known as Novocain. Novocain was adopted as the standard local anesthetic in the medical profession shortly after its inception in 1905. While its anesthetic capabilities were weaker than cocaine, Novacain proved to be the safest, effective alternative to cocaine. Although it has been replaced by Lidocaine, Novocain is still used today, most commonly in dentistry.

Born in Hamburg, Germany, Einhorn studied at the University of Tübingen before earning his degree in 1880. He worked as a research chemist at Meister, Lucius & Brüning and Bayer Laboratories.

Photo credit: Courtesy of Wright State University

Orville Wright

Flying-Machine

Patent No. 821,393

Born August 19, 1871
Died January 30, 1948

Inducted in 1975

Orville and Wilbur Wright, American inventors and aviation pioneers, achieved the first powered, sustained, and controlled flight of an airplane. The Wright brothers are considered inseparable in their aeronautical work. Wilbur was born in Millville, Indiana; Orville in Dayton, Ohio. They were the sons of a bishop of the Evangelical United Brethren Church. Both completed high school courses, but neither graduated formally.

As youngsters, they read many technical articles and books in their spare time. They also were deeply interested in the idea of mechanical flight and read about Otto Lilienthal's successful gliding experiments in Germany. In 1893 the brothers opened a shop for the sale, repair, and manufacture of bicycles. Income from the shop supported them during the early years of their aeronautical experiments. From their studies and observations, the brothers theoretically solved the problem of lateral stability. They then built their first machine in 1899, a biplane kite, which they fitted with wings that could be mechanically twisted.

Before attempting a powered flight, they decided to master gliding and built three biplane gliders, which they flew at Kitty Hawk and Kill Devil Hills on the Outer Banks of North Carolina. They completed their first powered machine, the Kitty Hawk, in 1903, and made history's first powered, sustained and controlled airplane flights from level ground without assistance at takeoff on the morning of December 17, 1903.

Photo credit: Courtesy of Wright State University

Wilbur Wright

Flying-Machine

Patent No. 821,393

Born April 16, 1867
Died May 30, 1912

Inducted in 1975

This first plane had a 12-horsepower engine running at 1,200 rpm and weighing 170 pounds. It also had propellers designed by the Wrights which exceeded their theoretical calculations.

After the first flight, the Wright brothers conducted further experiments in Dayton. By the end of 1904, they could stay in the air for five minutes, and in 1905, they sustained flight for over 24 miles.

In 1908 they were able to conclude an agreement for production of the Wright airplane for the U.S. Army. Wilbur made the first public flight on August 8, 1908 in France and continued his exhibition flights there to the end of that year, establishing many distance and altitude records.

Both the brothers died bachelors; aviation had been their only passion. In 1948, the original Wright plane was put on display at the Smithsonian Institution in Washington, D.C. It serves to emphasize the fact that the Wright brothers were true aviation pioneers, bridging the gap between downhill gliding flight and sustained power flight.

Photo credit: Oberlin College Archives, Oberlin, Ohio

John Raphael Rogers

Matrix for Linotype-Machine

Patent No. 837,127

Born December 11, 1856
Died February 18, 1934

Inducted in 2007

John Rogers invented an improved version of automatic typesetting, significantly advancing typography.

His work began by focusing on the problem of justification, attempting to vary the spaces between words so the ends of each line of type would align to produce columns. Before Rogers, skilled typesetters had to manually insert blank type of varying sizes once the line was completely set in order to justify it. Rogers invented a wedge-shaped mechanism that, together with a band, allowed each line of type to be automatically justified after it was set.

Born in Roseville, Illinois, Rogers received his A.B., A.M., and D. Sc. degrees from Oberlin College, and his LL.D. degree from Berea College. He established the Rogers Typograph Company but became entangled in lawsuits with Ottmar Mergenthaler's Linotype Company. In 1895, to resolve the dispute between the two companies, Mergenthaler's company bought Rogers' company, and Rogers went to work for Linotype as an engineer and head of the research department. Rogers continually improved Mergenthaler's original Linotype design with his own patented innovations, which kept the Linotype as an industry standard into the 1950s.

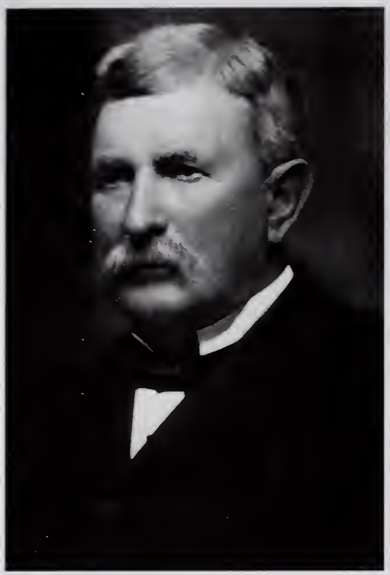


Photo credit: Caterpillar, Inc.

Benjamin Holt

Traction-Engine

Patent No. 874,008

Born January 1, 1849
Died December 5, 1920

Inducted in 2006

Benjamin Holt set about to find a way to aid farmers whose heavy equipment sank in soft, muddy soil. Finding wheels ineffective, Holt designed a track-laying system to disperse the weight. In 1904, Holt successfully tested the first practical track-type tractor known as the "Caterpillar®" and commercialized its use.

Holt made numerous innovations and by 1908 was able to replace steam engines and introduce gasoline-powered tractors, which offered greater efficiency in operation. Originally developed to solve local agricultural problems, the Caterpillar track-type tractor soon demonstrated its potential not only in the agricultural environment, but also in road building, earthmoving, logging, and military operations. Used extensively by the U.S., French, and British armies in World War I, the track-type tractor hauled men and supplies across the battlefield. From 1914 to 1918, 10,000 Caterpillar tractors were made by Holt's company and other licensed manufacturers for use in the war. Holt's track-type tractor contributed to the design of the British tank, which profoundly altered ground warfare tactics.

Holt Manufacturing merged with its competitor C.L. Best Tractor Co. in 1925, forming the Caterpillar Tractor Co., predecessor to modern-day Caterpillar Inc. Born in Concord, New Hampshire, Holt ushered in the modern era of mechanized farming.

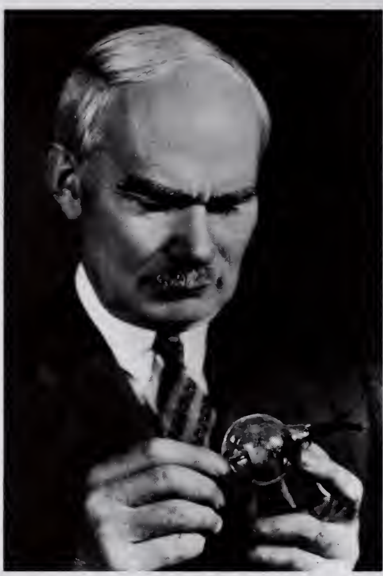


Photo credit: IEEE (Center for the History of Electrical Engineering)

Lee de Forest

Space Telegraphy

Patent No. 879,532

Born August 26, 1873
Died June 30, 1961

Inducted in 1977

In the early 1900s, the great requirement for further development of radio was an efficient and delicate detector of electromagnetic radiation. Lee de Forest provided that detector.

Born at Council Bluffs, Iowa, de Forest at an early age exhibited the inventive talents that were to make him famous. His father sent him to the Mt. Hermon (Massachusetts) School for Boys and from there he entered Yale University. While in college, he continued to invent—an improved typebar movement for his typewriter, an improved compass joint, a "puzzle game"—all to help defray his expenses. After receiving his B.S., he continued his studies at Yale and received his Ph.D. in 1899.

De Forest's doctorate thesis was on the "Reflection of Hertzian Waves from the Ends of Parallel Wires"; thus began his long career in radio. De Forest found a clue to creating the long-sought detector of electromagnetic radiation in John A. Fleming's invention of the so-called electronic valve. The most serious drawback of the Fleming valve was that it was relatively insensitive to changes in the intensity of incident electromagnetic radiation. Moreover, the Fleming valve could act only as a rectifier, not an amplifier.

De Forest's simple but revolutionary answer was to insert a third electrode between the cathode and the anode. The audion amplifier was the most important of de Forest's more than 300 patents.

Photo credit: Courtesy of Hoover Historical Center/ Walsh University

James Murray Spangler

Carpet Sweeper and Cleaner

Patent No. 889,823

Born November 20, 1848
Died January 22, 1915

Inducted in 2006

James Spangler invented the first commercially successful portable electric vacuum cleaner, an invention that revolutionized household carpet cleaning.

Spangler was born in Pennsylvania but moved to Ohio at an early age. While working as a janitor in a Canton, Ohio department store, Spangler developed a better carpet sweeper. He tinkered with an old fan motor, attached it to a soapbox stapled to a broom handle, and used a pillowcase as a dust collector. Spangler's vacuum cleaner was the first to use both a cloth filter bag and cleaning attachments. He improved this basic model and received a patent for it in 1908.

Spangler formed the Electric Suction Sweeper Company to manufacture his new vacuum cleaner. One of his first customers was his own cousin, who was married to William Hoover, a saddle maker and leather merchant who was impressed with Spangler's vacuum cleaner. Hoover invested in the inventor's business and patents and became president of the Electric Suction Sweeper Company. Hoover renamed the company the Hoover Company in 1922, and Spangler worked at the company as superintendent of day-to-day operations.

Under the Hoover name, Spangler's original vacuum was continually improved in the twentieth century. Today, the Hoover Company is a multi-million dollar business and common household name.

Photo credit: Bureau of Mines, U.S. Department of Interior

Frederick G. Cottrell

Art of Separating Suspended Particles from Gaseous Bodies

Patent No. 895,729

Born January 10, 1877
Died November 16, 1948

Inducted in 1992

As industrial smokestacks became common at the turn of the century, Frederick Cottrell realized that pollution might be controlled and that valuable raw materials were vanishing into the atmosphere with the unwanted gases. In 1907 he applied for a patent for a device that passed high-voltage direct current to a discharge electrode which leaked the charge onto particles passing by in the fumes.

These charged particles were then electrically attracted to an electrode with an opposite charge, where they could be collected and retrieved as valuable minerals or chemical compounds. Cottrell's electrostatic precipitator, which became known simply as a "Cottrell," removed from 90 to 98 percent of all particles from escaping smoke and gases. The term "cottrell" can still be found in the unabridged dictionary.

Cottrell was born in Oakland, California, and received his B.S. from the University of California at Berkeley. He taught high school chemistry before receiving his doctorate from the University of Leipzig in 1902. In 1912, Cottrell co-founded Research Corporation, a nonprofit group that returned money from inventions back into the advancement of science. Research Corporation has since funded basic research on such important inventions as Williams' Vitamin B1, Goddard's rockets, and Lawrence's cyclotron.

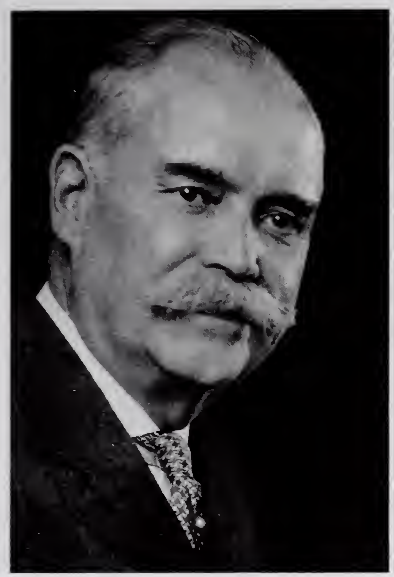


Photo credit: Image in the Public Domain

Thomas E. Murray

Electric Fuse Box

Patent No. 913,754

Born October 21, 1860
Died July 21, 1929

Inducted in 2011

Thomas E. Murray was an American inventor, entrepreneur, and influential figure in electric utilities at the beginning of the 20th century. He left school at age nine when his father died to begin helping to support his family. In 1875, he was hired by the Albany Iron and Machine Works as an apprentice, and by age 21 he was Chief Engineer of the Albany Waterworks.

Working with Anthony N. Brady, he moved from Albany to New York City, and organized, consolidated, and expanded New York City's electrical generation and transmission systems. He oversaw the building of major power stations that powered the city for the first half of the 20th century. His 462 patents covered everything from power plants to light sockets, including fuses, meters, switches, conduits, sockets, and dimmers.

His inventions improved the safety of interior electric wiring which helped give birth to the electrical appliance industry. Here his patents included an apartment refrigerator, air conditioner, and a dishwasher. Concerned about the environment, he patented anti-pollution devices for smokestacks. In 1910 he was awarded the Longstreth Medal from the Franklin Institute in Philadelphia for Safety Devices for Interior Electric Wiring.

Photo credit: Leo Baekeland Papers, National Museum of American History

Leo Hendrik Baekeland

Method of Making Insoluble Products of Phenol and Formaldehyde

Patent No. 942,699

Born November 14, 1863
Died February 23, 1944

Inducted in 1978

Leo Hendrik Baekeland is cited for his research in electric insulation, synthetic resins, and plastics. Using money from his first invention, Velox photographic paper, he established a laboratory where he synthesized "Bakelite," a nonflammable material that was cheaper and more versatile than other known plastics. Bakelite has since been used in everything from engine parts to jewelry to electronics.

Born in Ghent, Belgium, Baekeland graduated with a B.S. in chemistry from the University of Ghent in 1882 and a doctoral degree in 1884. He was awarded honorary degrees from the University of Pittsburgh and the University of Edinburgh. Baekeland was a professor of chemistry at the University of Ghent from 1882 to 1889 and a professor of chemistry and physics at the Government Higher Normal School of Science, Bruges, Belgium, from 1885 to 1887. In 1893 he founded Nepera Chemical Company, which he operated until 1899. He was president of the Bakelite Corporation from 1910 to 1939.

Baekeland was a member of the U.S. Naval Consulting Board and the U.S. Nitrate Supply Commission, chairman of the committee on patents of the National Research Council, trustee of the Institute of International Education, and a member of the advisory board of the Chemical Division of the U.S. Department of Commerce.

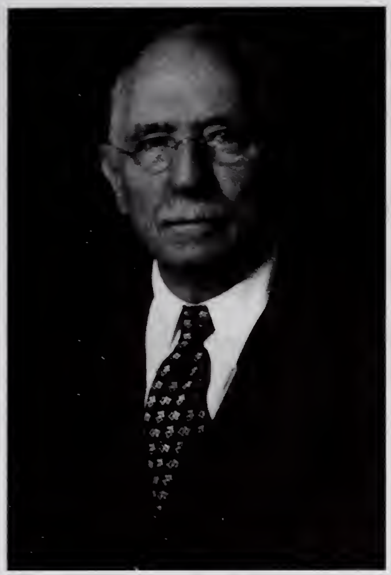


Photo credit: Milne Special Collections and Archives Department, University of New Hampshire Library, Durham, NH

Albert Kingsbury

Thrust Bearing

Patent No. 947,242

Born December 23, 1863
Died July 28, 1943

Inducted in 2007

Albert Kingsbury invented novel designs for thrust bearings in the early 20th century. Their introduction into the machine industry contributed significantly to increasing the longevity and performance of many devices, including compressors, propeller shafts, and turbines.

Born in Morris, Illinois, Kingsbury studied at Cornell University before teaching at universities for fourteen years. During this time, he developed the concept for a thrust bearing, which consisted of a shaft rotating within a bearing housing. This housing contained a series of ring bearings and washers, the latter of which could be manipulated and placed between the ring-bearing segments to create the maximum pressure necessary for lubrication.

Kingsbury's design provided a simple and durable bearing that could withstand the high pressure exerted upon it and remain sufficiently lubricated during the thrust bearing's operation. Kingsbury would continue to improve upon his design and patent numerous bearing designs throughout his professional life.

Kingsbury's thrust bearing became an integral component for industrial machinery in the first half of the twentieth century and was outfitted on a large number of the U.S. Navy's ships during the First and Second World Wars.

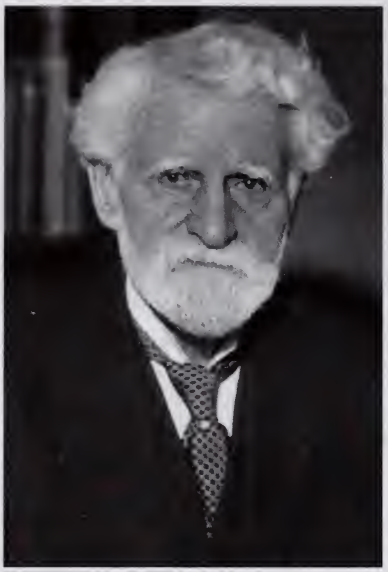


Photo credit: Special Collections, Cleveland State University Library

Ambrose Swasey

Telescope

Patent No. 959,179

Born December 19, 1846
Died June 15, 1937

Inducted in 2006

Ambrose Swasey, inventor of precise astronomical instruments, designed some of the most powerful and accurate telescopes of his day.

Swasey was born in Exeter, New Hampshire. Apprenticed to a machine works at age eighteen, he showed a natural aptitude for mechanics. With Worcester R. Warner, he founded the Warner & Swasey Company in 1880. Although machine tools were the company's main focus, their astronomical instruments brought them world renown.

Two great telescopes the partners designed and built were a thirty-six-inch refractor, the largest of its time, for the University of California's Lick Observatory, and the twenty-five percent more powerful Yerkes refractor. Swasey also perfected a tool to divide meridian circles, the dividing engine, that was accurate to within one inch of arc in a three-mile radius circle. His mastery of precision yielded highly regarded gun sights, range finders, field telescopes, and binoculars as well.

A founding member of the American Society of Mechanical Engineers, Swasey encouraged scientific progress. He contributed generously to the United Engineering Society and endowed a professorship at Case School of Applied Sciences (Case Western Reserve University). With Warner, he donated observatories to Case and to Denison University.

Photo credit: Niels Bohr Archive, courtesy AIP Emilio Segrè Visual Archives

Fritz Haber

Production of Ammonia

Patent No. 971,501

Born December 9, 1868
Died January 29, 1934

Inducted in 2006

At a time when no solution could be found, Fritz Haber successfully developed an inexpensive method for synthesizing ammonia needed for the industrial production of fertilizers, serving as an essential component for exponential global agricultural growth.

During the early 1900s, scientists faced the eventual depletion of the natural resource Chilean saltpeter (sodium nitrate). Without nitrogen-based fertilizers to increase crop yields, agricultural output would be severely reduced. Using the inexhaustible source of nitrogen in the atmosphere, Haber began investigating the possibility of combining nitrogen from the atmosphere with hydrogen to form ammonia. By 1908 Haber had succeeded in developing an ammonia synthesis process that worked in the laboratory.

Using Haber's breakthrough, Karl Bosch refined the process created in the laboratory and developed the necessary equipment for producing ammonia on an industrial scale. The Haber-Bosch process has remained unchanged since the early 1900s and is used today to manufacture thousands of tons of ammonia worldwide.

Haber was born in Breslau, Germany. He studied at the University of Heidelberg, earning his Ph.D. in 1891. Regarded as one of the most influential chemists of his generation, Haber won the Nobel Prize in Chemistry in 1918 for his process for synthesizing ammonia.

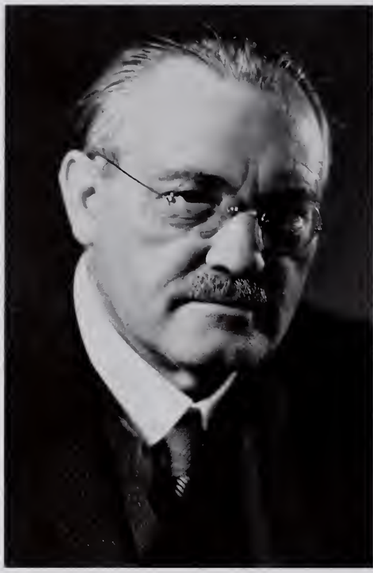


Photo credit: Edgar Fahs Smith Collection, University of Pennsylvania Library

Carl Bosch

Process of Producing Ammonia

Patent No. 990,191

Born August 27, 1874
Died April 26, 1940

Inducted in 2006

Carl Bosch transformed global agriculture by advancing the Haber process for producing ammonia, making it commercially practical to produce large quantities of the compound. The Haber-Bosch process remains an industry standard for the mass production of ammonia used for manufacturing fertilizer.

Using principles from Fritz Haber's discovery, Bosch devised a method for separating large quantities of hydrogen from a hydrogen-carbon monoxide mixture. In 1909, under Bosch's leadership, BASF acquired the patent rights for Fritz Haber's ammonia process and began developing the equipment and refining the process needed for mass production. By 1913, the BASF works at Oppau, Germany began the first worldwide production of ammonia.

During World War I, BASF expanded its production facilities, and by 1918 Germany was generating more than 200,000 tons of synthetic ammonia annually for use in fertilizers and explosives.

Bosch was born in Cologne, Germany. He studied chemical engineering at the Technical University in Charlottenburg, Germany before receiving his Ph.D. from the University of Leipzig in 1898. Bosch won the Nobel Prize in Chemistry in 1931 for his contribution to the invention and development of high-pressure technology in the chemical industry.

Photo credit: Wisconsin Historical Society Inage ID #96511

Ole Evinrude

Marine Propulsion Mechanism

Patent No. 1,001,260

Born April 19, 1877
Died July 12, 1934

Inducted in 2007

Ole Evinrude conceived, designed, and manufactured the first practical, commercially successful outboard motor. His first design, a 1 1/2 horsepower, 62-pound iron engine, brought the pleasure of boating to everyone.

Born in Christiania, Norway, Evinrude immigrated to Cambridge, Wisconsin at age five. He apprenticed in machine factories in the Midwest, studying engineering on his own time. Addressing the problem of large, bulky boat motors, Evinrude designed a horizontal cylinder, a vertical crankshaft, and a drive shaft with direction-changing gears housed in a submerged lower unit. In 1920, he followed with the improved ELTO (Evinrude Light Twin Outboard), which was quieter and weighed 25 pounds less. Further refinements, such as a lighter engine made of aluminum and the doubling of horsepower, made Evinrude's outboard motor successful for decades.

Evinrude's legacy survives in the outboard motors still used by recreational boaters, fishermen, and the U.S. military since World War II. Outboard Marine Corporation, successor to Evinrude's companies, had revenues of over $1 billion in 1995. Outboard Marine was acquired by Bombardier, Inc. in 2001, which continues to manufacture and sell the still-popular Evinrude motors.

Photo credit: Henry Ford Museum and Greenfield Museum

Henry Ford

Transmission Mechanism

Patent No. 1,005,186

Born July 30, 1863
Died April 7, 1947

Inducted in 1982

Pioneering automotive engineer Henry Ford held many patents on automotive mechanisms. He is best remembered, however, for helping devise the factory assembly approach to production that revolutionized the auto industry by greatly reducing the time required to assemble a car.

Born in Wayne County, Michigan, Ford showed an early interest in mechanics, constructing his first steam engine at the age of 15. In 1893 he built his first internal combustion engine, a small one-cylinder gasoline model, and in 1896 he built his first automobile.

In June 1903, Ford helped establish Ford Motor Company. He served as president of the company from 1906 to 1919 and from 1943 to 1945. In addition to earning numerous patents on auto mechanisms, Ford served as a vice president of the Society of Automotive Engineers when it was founded in 1905 to standardize U.S. automotive parts.

Photo credit: City Historian's Archives, Schenectady, NY

Ernst F.W. Alexanderson

High-frequency Alternator

Patent No. 1,008,577

Born January 25, 1878
Died May 14, 1975

Inducted in 1983

Ernst Alexanderson was the General Electric Company engineer whose high-frequency alternator gave America its start in the field of radio communication. During his 46-year career with G.E., Swedish-born Alexanderson received 322 patents. He produced inventions in such fields as railway electrification, motors and power transmissions, telephone relays, and electric ship propulsion, in addition to his pioneer work in radio and television. In 1904, Alexanderson was assigned to build a high-frequency machine that would operate at high speeds and produce a continuous-wave transmission.

After two years of experimentation, Alexanderson finally constructed a two-kilowatt, 100,000-cycle machine. It was installed in the Fessenden station at Brant Rock, Massachusetts, on Christmas Eve, 1906. It enabled that station to transmit a radio broadcast which included a voice and a violin solo.

Alexanderson's name will also be recorded in history for his pioneer efforts in television and the transmission of pictures. In 1927 he staged the first home reception of television using high-frequency neon lamps and a perforated scanning disc. He gave the first public demonstration of television on January 13, 1928.

Photo credit: Courtesy of the Library of Congress [LC-USZ62-120859]

Peter Cooper Hewitt

Apparatus for the Electrical Production of Light

Patent No. 1,030,178

Born March 5, 1861
Died August 15, 1921

Inducted in 2011

Peter Cooper Hewitt patented the mercury vapor lamp which was widely used for street and outdoor lighting. A graduate of Columbia University, he was experimenting with electric conductivity and was able to prove that a gas can conduct an electrical charge. By doing this, he was able to pass an electric current through mercury gas sealed in a quartz tube. His invention is a prototype of today's modern fluorescent lights.

The incandescent lamps that were being used in the 1890s converted only 5% of the energy used into light and converted the other 95% to heat. To address this problem, Hewitt created a discharge lamp in which mercury vapor was heated by the current passing through it. The efficiency was much higher than incandescent lamps but the emitted light was of a bluish-green unpleasant color, which limited its use. Hewitt continued work on his vapor lamp and soon discovered he could balance the light by adding elements to the vapor and a transformer that stepped up the current and excited the new elements.

Hewitt went on to serve on the newly formed Inventor's Guild in New York City created in 1890 to further the interests and secure the rights of those who made contributions in the fields of science and technology.

Photo credit: Science, Industry and Business Library, The New York Public Library, Astor, Lenox and Tilden Foundations

Beulah Louise Henry

Ice Cream Freezer

Patent No. 1,037,762

Born September 28, 1887
Died February 1973

Inducted in 2006

Beulah Henry became known as "Lady Edison" for the number and variety of devices she invented that made daily life easier. The first of her inventions, a vacuum-sealed ice cream freezer, was patented in 1912. Henry went on to be considered the most prolific woman inventor of the 1920s, and continued to innovate for several decades.

Henry's wide array of inventions included the "protograph," a typographical device that produced an original and four typewritten copies without carbon paper; a lockstitch bobbinless sewing machine; an umbrella with interchangeable snap-on covers to coordinate with the user's outfit; the "Kiddie Clock," which helped children learn to tell time; the "Miss Illusion" doll, with eyes that changed colors at the touch of a button; and continuously attached envelopes for original and return mailings.

Born in Memphis, Tennessee, Henry was self-educated, crediting her inventiveness to inspiration. The inventor said that she had a complete picture of each finished product in her mind before she began the difficult task of describing her idea clearly enough to enable a model maker to reproduce each device as she envisioned it. In all, Henry was granted 49 United States patents over the course of her career and is responsible for over 100 inventions.

Photo credit: Permission given by Amoco Corporation

William Meriam Burton

Manufacture of Gasolene

Patent No. 1,049,667

Born November 17, 1865
Died December 29, 1954

Inducted in 1984

Chemist and oil industry executive William Meriam Burton recognized the need for altering the methods of refining crude oil at the turn of the century to produce gasoline and developed the first commercially successful process for cracking crude oil into gasoline and other products.

Born in Cleveland, Ohio, Burton received his preliminary education at public schools in his hometown and graduated with a B.A. from Western Reserve University in 1886. He did graduate work in chemistry at Johns Hopkins University and received a Ph.D. in 1889.

Burton started work at Standard Oil in Cleveland as a chemist and in 1890 transferred to Standard Oil of Indiana. There he later served as assistant superintendent and in 1895 became superintendent of the refinery. He was elected a director of the company in 1911, vice president in 1915, and president in 1918. He continued as president until he retired in 1927.

Burton demonstrated the value of laboratory research and testing, and the cracking process he developed more than doubled the potential yield of gasoline from crude oil. During its first 15 years in use the process saved more than one billion barrels of crude oil.

1914-1938
The Brink of the Modern Era

The crisis of World War I (1914-1918) sparked new developments in electronics, especially wireless telegraphy and radio. The government supported this war-related research but did not commit to long-term support of science and technology. Instead, inventors took advantage of educational opportunities and joined the ever-expanding laboratories of universities and corporations. Improved vacuum tubes, the key components of all early electronics such as radio and a new device called television, were some of the breakthroughs made in these "invention factories." Researchers also began mimicking nature in the laboratory, breeding new plant species and creating artificial fibers such as nylon. Public expectations for the power of science and technology exploded as electricity and new products became widely available, and inventors remained popular heroes.

Photo credit: The Western Reserve Historical Society, Cleveland, Ohio

Garrett Morgan

Breathing Device; Traffic Signal

Patent Nos. 1,090,936; 1,475,024

Born March 4, 1877
Died August 27, 1963

Inducted in 2005

Garrett Augustus Morgan produced a series of successful inventions in the beginning of the 20th Century.

Morgan's first well-known invention was the safety hood, a forerunner of the gas mask. The hood was popularized during a tragic accident in Cleveland, Ohio. When 32 workers were trapped during a tunnel collapse under Lake Erie in 1916, rescuers were unable to reach them because smoke, dust and fumes blocked their way. Morgan and several volunteers using the masks were able to reach the trapped men and rescue several survivors.

In 1923, Morgan patented his best-known invention, the three-way traffic signal. As an early enthusiast of automobiles, Morgan quickly recognized the need for better traffic control on congested city streets. His signal was based on signs that signaled stop and go. He sold his patent rights for $40,000 to General Electric, which developed an electric version.

Born in Paris, Kentucky, Morgan settled in Cleveland as a young man. He was an advocate for racial equality, forming one of the first black fraternities in the country at Cleveland's Western Reserve University. As a self-educated black man he was concerned with the safety and welfare of his fellow citizens. He was honored as a pioneering citizen at the Emancipation Centennial Celebration in 1963.

Photo credit: Courtesy of Lionel

Joshua Lionel Cowen

Toy Car

Patent No. 1,113,312

Born August 25, 1877
Died September 8, 1965

Inducted in 2007

Joshua Lionel Cowen invented model railroads in the early 20th century.

Born in New York City, Cowen attended the Cooper Union and Columbia College. He spent numerous years experimenting with flash lamps, using electrical current to set off a charge of magnesium flash powder to provide a burst of light for indoor photography. After tinkering with other uses for electrical current, Cowen envisioned using a small electric motor, which he had attached to a blade to make a battery-powered fan, to move a miniature car around a set of handmade tracks. He pitched the idea to a local toy store, and the owner ordered several sets.

The popularity of Cowen's toy train was due in part to timing. America's railroads were at the zenith of their importance in the early years of the twentieth century, and Cowen's miniature locomotives and cars showed a fascination with the machinery that made America work. Much of the success of Cowen's firm—called Lionel after his middle name—had to do with his relentless improvements and innovations to his model train systems. He also went to great lengths to produce accurate replicas of real trains, from the correct number of rivets on a locomotive to model freight cars that automatically unloaded miniature cargo.

Photo credit: Courtesy of the George Eastman House

Frederic Eugene Ives

Color Photography

Patent No. 1,145,143

Born February 17, 1856
Died May 27, 1937

Inducted in 2011

Frederic Ives was a pioneer of color and stereoscopic photography, and demonstrated a system of natural color photography at the 1885 Novelties Exposition of the Franklin Institute.

Ives' first color process developed was the Photochromoscope system. He employed subtractive color theory to record scenes with a one-shot stereoscopic camera. Ives' camera system of mirrors and filters behind each lens split and filtered the light to create one pair of slides for each primary color of light. Though his Photochromoscope system was on sale for several years, due to its cost, it was commercially unsuccessful. However, Ives traveled extensively throughout the U.S. and Europe during this time period, often taking the only existing color photographs of his subjects.

Ives also introduced a halftone process of photoengraving where photographs are broken down to tiny dots of varying size and uniform spacing creates the illusion of subtle shading. This half-tone process is still used in newspapers, offset copy machines, and laser printers. Prior to this innovation, imagery in print was reproduced by a time-consuming process of highly skilled wood engraving. In his lifetime, Ives created many other inventions dealing with optics, printing, and photography.

Photo credit: G.M. Media Archives

Charles Franklin Kettering

Engine Starting Device; Lighting and Ignition System

Patent Nos. 1,150,523; 1,171,055

Born August 29, 1876
Died November 25, 1958

Inducted in 1980

Charles Franklin Kettering invented the first electrical ignition system and the self-starter for automobile engines and the first practical engine-driven generator. Born in an Ohio farmhouse, Kettering graduated from Ohio State University in 1904 as an engineer. He then joined the National Cash Register Company, where he oversaw development of the electrically operated cash register, among other products.

In 1909 he left NCR and, with businessman Edward A. Deeds, set up the Dayton Engineering Laboratories Company or Delco, where he invented his most significant engine devices. Kettering's engine-driven generator, named the "Delco," provided electricity on millions of farms. In 1916 Kettering sold his company to General Motors. At G.M. he set up and directed a central research laboratory and stayed for 31 years, until his retirement in 1947.

The lab developed the lightweight diesel engine that made the diesel locomotive possible, the refrigerant Freon, four-wheel brakes, safety glass, and many other items. Kettering was the holder of some 140 patents. Along with G.M. President Alfred Sloan, he established the Sloan Kettering Institute for Cancer Research.

Photo Credit: *Courtesy of Library of Congress, Prints and Photographs Division, LC-USZ62-106325*

Glenn Hammond Curtiss

Hydroaeroplane

Patent No. 1,170,965

Born May 21, 1878
Died July 23, 1930

Inducted in 2003

Glenn Curtiss influenced every field of aeronautics. He holds 72 patents, including designs for dirigibles, aeroplanes, flying boats, commercial aircraft, and Navy planes. Curtiss built one of the first flying machines to land in water and founded one of the first companies created specifically for manufacturing airplanes.

Curtiss was born in Hammondsport, New York and opened a motorcycle shop in 1901. Respected for his quality motorcycle engines, Curtiss built the engine for the California Arrow, the first successful dirigible in America. He also worked for Alexander Graham Bell in the Aerial Experiment Association, designing the June Bug. It included ailerons– a device controlling the lateral balance of an airplane– making the Wright's wing-warping obsolete. In 1911, Curtiss designed a seaplane for the Navy, adding retractable landing gear to his design. By the start of World War I, Curtiss was the largest American aircraft manufacturer. His most famous design was the Jenny, which was primarily a military training aircraft for WWI and later used for barnstorming and mail delivery.

Glenn Curtiss is considered the most influential man in the evolution of aviation. His keen insight into aeronautics and aviation, despite having no formal education past eighth grade, affirms his genius. He holds the Collier Trophy and the Langley Medal.

Photo credit: Courtesy of the Riverbank Acoustical Laboratory

Wallace Clement Sabine

Device for Preventing the Transmission of Sound

Patent No. 1,172,838

Born June 13, 1868
Died January 10, 1919

Inducted in 2011

Wallace Sabine was an American physicist who created the field of architectural acoustics. In 1895, Sabine, on the faculty at Harvard University, was asked by the university president to improve the poor acoustics in a lecture hall in the newly opened Fogg Art Museum. Sabine embarked on the challenge by trying to determine what made the Fogg Lecture Hall different from other acoustically acceptable facilities. In particular, the Sanders Theater on the Harvard campus was considered acoustically excellent. Through experiments, Sabine was able to determine the relationship between the quality of acoustics, the size of the chamber, and the amount of absorption surfaces present. He also formally defined reverberation time, which is still the most important characteristic currently in use for gauging the acoustical quality of a room.

Using what he discovered, Sabine deployed sound-absorbing materials throughout the Fogg Lecture Hall to cut its reverberation time down and reduce the "echo effect." This accomplishment established Sabine's career and led to his becoming the acoustical consultant for Boston's Symphony Hall, the first concert hall to be designed using quantitative acoustics. The unit of sound absorption, the sabin, was named after him.

Photo credit: General Electric Research & Development Center

Irving Langmuir

Incandescent Electric Lamp

Patent No. 1,180,159

Born January 31, 1881
Died August 16, 1957

Inducted in 1989

Irving Langmuir's work led to two major inventions: the high-vacuum electron tube and the gas-filled incandescent lamp. Born in Brooklyn, New York, Langmuir was educated in the public schools of New York and Paris, France. He earned a B.S. from the Columbia University School of Mines and a Ph.D. from the University of Gottingen in Germany. His first professional position was as a chemistry instructor at Stevens Institute in Hoboken, New Jersey. From there he moved to the General Electric Research Laboratory in Schenectady, New York. While at G.E., Langmuir received 63 patents and was awarded the 1932 Nobel Prize for Chemistry, among many other honors. His initial research at General Electric involved low-pressure chemical reactions and the study of the emission of electrons by hot filaments in a vacuum. This work led directly to the invention of the high-vacuum electron tube in 1912 and the gas-filled incandescent lamp in 1913.

Langmuir was responsible for many basic scientific discoveries. His contributions to atomic theory and the understanding of atomic structure threw light upon the meaning of isotopes. His experiments with oil films on water resulted in the development of two-dimensional or surface chemistry. In World War II, Langmuir was one of the key advisers in the national defense and wartime scientific research programs, contributing to the development of radar for use by the British and United States armed forces.

Photo source: Harlinque - Viollet

Georges Claude

Neon Tubing

Patent No. 1,189,664

Born September 4, 1870
Died May 23, 1960

Inducted in 2007

French industrial chemist Georges Claude invented neon tubing.

Born in Paris, France, he studied at École de Physique et Chinie before graduating in 1886. He used his education in chemistry and began experimenting with noble gases, trying to find practical uses for them. Having discovered that neon was sensitive to electricity and would glow if enough voltage was delivered through it, Claude worked to put neon in glass tubes with sufficient purity to allow electrodes at each end to use electricity to illuminate the neon. After a successful display at the Paris Art Show in 1910, Claude conceived the idea of bending glass tubing in order to form letters, developing the first neon sign.

The first neon sign in the United States was brought to Los Angeles from Paris in 1922 to advertise the Packard Agency. During the 1920s, vivid neon signs became the trend in advertising.

After his neon sign businesses had become profitable, Claude turned his attention to using the thermal difference between layers of the ocean to create electric power. During World War II, Claude collaborated with the Nazi-run Vichy government in France, and was put in prison from 1945-1949.

Photo credit: General Electric Research & Development Center

William D. Coolidge

Vacuum Tube

Patent No. 1,203,495

Born October 23, 1873
Died February 4, 1975

Inducted in 1975

William D. Coolidge's name is inseparably linked with the X-ray tube–popularly called the "Coolidge tube." This invention completely revolutionized the generation of X-rays and remains to this day the model upon which all X-ray tubes for medical applications are patterned. Coolidge, born in Hudson, Massachusetts, graduated from the Massachusetts Institute of Technology in 1896, majoring in electrical engineering. He received his Ph.D. in 1899 from the University of Leipzig. He later returned to MIT, working first as an instructor and later as an assistant professor.

Coolidge joined the staff of General Electric Company's Research Laboratory in 1905 and early in his career played a major role in the development of the modern incandescent lamp. He invented ductile tungsten, the filament material still used in such lamps.

He worked on many other devices such as high-quality magnetic steel, improved ventilating fans, and the electric blanket. During World War II he contributed research to projects involving radar and radar countermeasures. He was awarded 83 patents during his lifetime.

Photo credit: Archives of the Crawford County Historical Society, Meadville, PA

Gideon Sundback

Separable Fastener

Patent No. 1,219,881

Born 1880
Died June 21, 1954

Inducted in 2006

Swedish-born engineer Gideon Sundback improved on Whitcomb Judson's work, making the zipper practical and commercially successful. Today, thousands of miles of zipper are manufactured daily.

Working from Elias Howe's "Automatic, Continuous Clothing Closure" patent of 1851, Judson, in 1891, created a clasp locker for shoes and established the Universal Fastener Company. Although initially successful, Judson's locker lacked reliability, so he hired Sundback to make it reliable and practical.

Sundback increased the number of fastening elements from four to ten per inch, creating small teeth. He faced two rows of teeth opposite each other and added a slider to pull them together.

Sundback also developed the manufacturing machine and process for the new zipper. The "S-L" machine took a special Y-shaped wire and cut scoops from it, punching dimples to create teeth. Within the first year of production, the Universal Fastener Company was manufacturing hundreds of feet of fastener per day.

The United States Army applied zippers to the clothing and gear of troops during World War I. By the late 1920s, zippers could be found in all kinds of clothing, footwear, and carrying cases. The industrialist B. F. Goodrich coined the onomatopoeic term "zipper" in 1923.

Photo credit: Courtesy of AT&T Archives and History Center

George Ashley Campbell

Electric Wave Filter

Patent No. 1,227,113

Born November 27, 1870
Died November 10, 1954

Inducted in 2011

George Campbell was a leader in applying mathematical methods to the problems of long-distance telephony. His most important contributions were to the theory and implementation of loading coils and the first wave filters. In 1897, Campbell went to work for AT&T in Boston. Both of his innovations gave significant competitive advantage for his employer, as they permitted AT&T to carry multiple telephone messages on a single line over longer distances. Campbell's method for transmitting telephone signals over much greater distances was made possible by the insertion of loading coils into the line at carefully calculated intervals. Around this same time, Michael Pupin, a physicist at Columbia University, patented a similar system.

An important result of his theories on loading coils was Campbell's development of wave filtering in 1910. AT&T was attempting to use the same wires for many telephone conversations simultaneously; the filters were needed for reasons of privacy, as well as intelligibility, so there was no crosstalk between channels. Since the filter designs allowed multiple conversations to be sent over the same wire, they were of great economic value and resulted in substantial savings in cable installation costs.

Campbell attended both MIT and Harvard, and received both the IEEE Edison Medal and the IEEE Medal of Honor.

Photo credit: Courtesy of the Hagley Museum and Library

Elmer Ambrose Sperry

Ship's Gyroscopic-Compass Set

Patent No. 1,242,065

Born October 12, 1860
Died June 16, 1930

Inducted in 1991

Elmer Ambrose Sperry invented gyroscopic-guided automatic pilots for ships and airplanes that have also been applied to spacecraft. Born in Cortland, New York, Sperry completed his formal education at the State Normal and Training School in Cortland and formed the first of his eight companies, the Sperry Electric Company, at the age of 20.

He began work on gyroscopes in 1896, combining electrical and mechanical elements into gyroscopic compasses and stabilizers for ships and airplanes. His gyroscope-guided autopilot became known as a "Metal Mike," the mechanical helmsman. Sperry also organized the Sperry Electric Mining Machine Company and invented a continuous chain undercutter and an electric mine locomotive. In 1890 the Sperry Electric Railroad Company manufactured streetcars in Cleveland, Ohio. His other inventions included a gyroscopic turn indicator, which allowed flying without visual reference to the ground or horizon.

He developed high-intensity search lights following World War I and in 1928 invented a device to find transverse fissures in rails, which the American Railway Association called "one of the most important safety moves in years."

Photo credit: Hagley Museum and Library

Jacques E. Brandenberger

Composite Cellulose Film

Patent No. 1,266,766

Born 1872
Died July 13, 1954

Inducted in 2006

Invented in 1908, cellophane came from Swiss chemist Jacques Brandenberger's desire to create a clear, flexible, waterproof film that could be applied to cloth. After experimenting with different ways of applying liquid viscose rayon to cloth, Brandenberger discovered that a thin transparent film could be peeled off the top of the cloth. He realized this new material had many potential uses and focused his attention on it.

By 1912, Brandenberger had invented one of the first machines for large-scale production of cellophane, and built an industrial enterprise to manufacture the transparent wrap in Paris. With access to mass quantities, he created different uses for cellophane, including as a wrap for products and as a thin, flexible film over the eyepieces of gas masks. He was granted patents for his machinery and basic process in 1917, while working at La Cellophane Société Anonyme.

In 1923, La Cellophane sold the rights to the process to make and sell cellophane in North and Central America to the DuPont Cellophane Company. Although newer, more heat-resistant plastics emerged, Brandenberger's cellophane is still common in packaging.

Born in Zurich, Switzerland, Brandenberger's invention of cellophane and its widespread use earned him the Franklin Institute's Gold Medal.

Photo credit: Courtesy of Library of Congress; Prints and Photographs Division; [LC-DIG-npcc-06224]

John Hays Hammond, Jr.

System of Teledynamic Control

Patent No. 1,275,741

Born April 13, 1888
Died February 12, 1965

Inducted in 2011

John Hays Hammond, Jr. became interested in the new study of radio waves while studying at the Sheffield Scientific School of Yale University. After graduation from Yale in 1910, Hammond took a job at the U.S. Patent Office to learn what fields were at the forefront of innovation.

At the same time, he founded the Hammond Radio Research Laboratory in Gloucester, Massachusetts. Knowing that the U.S. Navy was interested in applying radio to warfare, Hammond began experimenting with radio-controlled devices. By 1914, he had laid the foundation for all subsequent radio remote control. In 1921, Hammond remotely controlled a battleship as it cruised Chesapeake Bay and went on to develop radio controlled torpedoes, missiles, and other weapons. He also contributed to the development of automatic stabilization by gyroscopes, the automatic pilot, and the idea of having torpedoes and missiles detonate when they came within proximity of a target.

Although he had inherited wealth, Hammond's inventions brought him additional fortune. His honors during his career include the Longstreth Medal. A prolific inventor, Hammond is credited with more than 800 foreign and domestic patents.

Photo credit: Courtesy of Corning Incorporated

Eugene Sullivan

Glass

Patent No. 1,304,623

Born January 23, 1872
Died May 12, 1962

Inducted in 2011

Eugene C. Sullivan left the U.S. Geological Survey and came to Corning where he founded the Corning Glass Works' research lab in 1908. With degrees in chemistry from the University of Michigan (B.S.), and graduate work in Germany at the Universities of Gottingen and Leipzig (Ph.D.), Sullivan began Corning's tradition of glass research to foster new development and continued innovation.

An evolution in borosilicate glass research helped solve the glass problems of the era. Shattered brakemen's lanterns were the source of all-too-frequent train crashes. Knowing that borosilicate glasses were a low expansion glass of great durability, Sullivan and fellow chemist William C. Taylor used borosilicates for their new lantern globes.

But it was the unheard-of application of borosilicate glass as bakeware that would make Corning a household name for the rest of the century. Sullivan and Taylor were responsible for the development of PYREX® brand cookware. This bizarre glass application was solely responsible for the paradigm shift that was to be glass' legacy – as a versatile engineering material.

Eugene C. Sullivan continued to influence research in the labs until his death. His legacy is honored today with the R&D facility that bears his name, Sullivan Park.

Photo credit: Corbis-Bettmann

Edwin Howard Armstrong

Method of Receiving High-Frequency Oscillations

Patent No. 1,342,885

Born December 18, 1890
Died February 1, 1954

Inducted in 1980

The inventions of engineer Edwin Howard Armstrong were so important that to this day every radio or television set makes use of one or more of his developments. Born in New York City, Armstrong earned a degree in electrical engineering from Columbia University in 1913. While in college, he invented the regenerative circuit, which was the first amplifying receiver and the first reliable continuous-wave transmitter.

In 1918, he invented the superheterodyne circuit, a highly selective means of receiving, converting, and greatly amplifying very weak, high frequency electromagnetic waves. His crowning achievement (1933) was the invention of wide-band frequency modulation, now known as FM radio.

Independently wealthy on royalties from his inventions, he neither drew a salary nor taught many classes as professor of electrical engineering at Columbia University.

Photo credit: Courtesy of the Chemical Heritage Foundation

Carleton van Staal Ellis

Food Product Containing Hydrogenated Oil

Patent No. 1,390,689

Born September 20, 1876
Died January 13, 1941

Inducted in 2011

Carleton van Staal Ellis was an inventor who used his knowledge of organic chemistry to contribute innovations and improvements in a wide range of industries and products. In addition to work on margarine, he also made contributions towards anti-knock gasoline, longer lasting house paint, more durable polyesters and plastics, improved printing inks, and methods for hydroponic plant growth. He also worked on Standard Oil's tube-and-tank method of oil cracking and discovered a way to economically fireproof aircraft wings during World War I.

Ellis was the author of *The Hydrogenation of Oils* as well as the first comprehensive treatise on synthetic resins and plastics. In 1933, he was issued the first U.S. patent for an unsaturated polyester, followed by a patent for polyester copolymers. His work is said to have resulted in over 100,000 compounds and to have made plastics an exact and lucrative science.

Ellis, who attended the Massachusetts Institute of Technology, was a recipient of the Longstreth Medal in 1916. The World War II Liberty ship the *S.S. Carleton Ellis* was named in his honor.

Photo Credit: Courtesy of the Thomas Fisher Rare Book Library, University of Toronto

Frederick Banting

Extract Obtainable from the Mammalian Pancreas or from the Related Glands in Fishes, Useful in the Treatment of Diabetes Mellitus, and a Method of Preparing It

Patent No. 1,469,994

Born November 14, 1891
Died February 21, 1941

Inducted in 2004

Millions of diabetics owe their lives to Frederick Banting's idea and research. Working with fellow Canadians Charles Best and James Collip, Banting determined that insulin was the key to treating diabetes. After discovering that the absence of insulin is the main factor in diabetes, they determined that injections of insulin might keep diabetics alive and developed techniques for extracting, isolating, and administering it.

Banting was born near Alliston, Ontario, and received a bachelor of medicine degree from the University of Toronto in 1916. He served as a military surgeon for the next two years in England and France, where he sustained serious shrapnel wounds. He returned to Canada, establishing a surgical practice in London, Ontario and serving as a medical demonstrator at the University of Western Ontario. Stimulated to research by the death of a childhood friend to diabetes, he conceived a technique to isolate the anti-diabetic component of the pancreas. He returned to the University of Toronto in 1921 to conduct experiments on the pancreas.

In 1923, Banting was awarded the Nobel Prize in Physiology or Medicine. He was knighted by King George V in 1934 and was elected a Fellow of the American College of Physicians and an honorary member of the Royal College of Surgeons and the Royal College of Physicians.

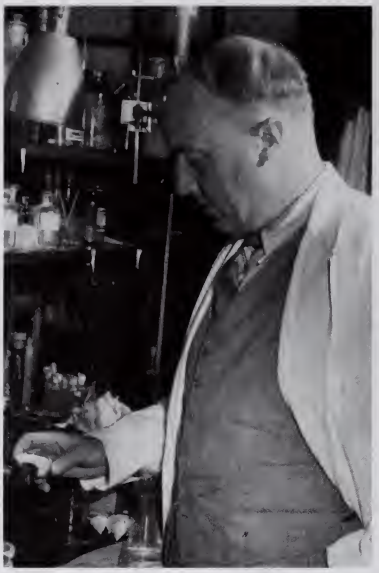


Photo Credit: Courtesy of the Thomas Fisher Rare Book Library, University of Toronto

Charles Best

Extract Obtainable from the Mammalian Pancreas or from the Related Glands in Fishes, Useful in the Treatment of Diabetes Mellitus, and a Method of Preparing It

Patent No. 1,469,994

Born February 27, 1899
Died March 31, 1978

Inducted in 2004

The youngest member of the team that provided life-saving treatment to diabetics started his historic work immediately after earning his bachelor's degree. Best was just 22 when he joined Frederick Banting in the search for answers about diabetes. Their first breakthrough occurred when they discovered that the hormone insulin, produced in the pancreas, was the substance needed to treat diabetes. Next, they moved on to the challenge of finding ways to extract and purify the vital hormone, and finally formulated methods for mass-producing insulin.

When it came time to begin commercial production, it was Best who took charge of the operation. In his later years, Best conducted important research on allergies, methods to preserve blood serum, and treatments to prevent seasickness.

Born in West Pembroke, Maine, Best moved to Nova Scotia with his parents early in life. He served in the Canadian Army during World War I and graduated from the University of Toronto with a B.A. in 1921, an M.A. in 1922, and an M.D. in 1925. He earned a D.Sc. from the University of London in 1928. He was a prolific author and the winner of numerous professional awards. The Charles H. Best Institute Research Laboratory, which specializes in diabetes research, is named in his honor.

Photo Credit: Courtesy of the Thomas Fisher Rare Book Library, University of Toronto

James Collip

Extract Obtainable from the Mammalian Pancreas or from the Related Glands in Fishes, Useful in the Treatment of Diabetes Mellitus, and a Method of Preparing It

Patent No. 1,469,994

Born November 20, 1892
Died June 19, 1965

Inducted in 2004

The process for producing enough pure insulin for clinical trials was developed by James B. Collip, a biochemist who provided a key contribution to the treatment of diabetes.

After Charles Best and Frederick Banting discovered insulin and proved that it could save the lives of diabetics, they encountered trouble finding ways to purify and extract the natural hormone. Collip solved the problem by devising the first successful process that could remove harmful impurities from insulin while retaining its life-saving qualities. Days after he produced a batch of his extract, it was used to save a 14-year-old boy who was near death from the ravages of diabetes. Collip went on to become a leading endocrinologist and a worldwide authority on the properties of insulin.

Born in Belleville, Ontario, Collip earned his B.A. from Trinity College in 1912 and his M.A. in 1913. He earned a Ph.D. in biochemistry from the University of Toronto in 1916. He conducted research at the University of Alberta, McGill University in Montreal, and the University of Western Ontario. He received numerous professional awards and honorary degrees.

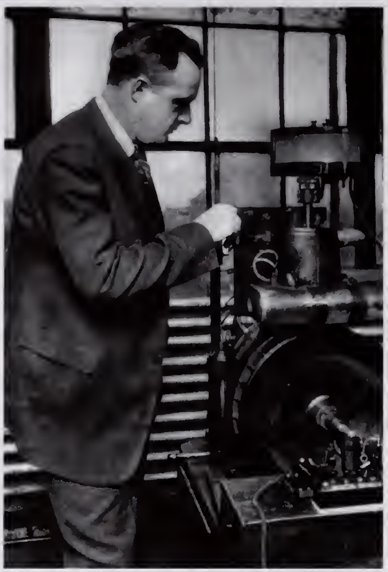


Photo Credit: Dayton Daily News

Thomas Midgley, Jr.

Motor Fuel

Patent No. 1,491,998

Born May 18, 1889
Died November 2, 1944

Inducted in 2003

Thomas Midgley solved the problem of engine knock by creating tetraethyl lead gasoline. His gasoline allowed high performance engines to operate efficiently. Midgley also developed Freon, which made refrigerators and air conditioners commonplace.

Born in Beaver Falls, Pennsylvania and educated at Cornell University, Midgley began work in 1916 in the research lab of the Dayton Engineering Laboratories Company. Using his knowledge of mechanical engineering and problem-solving, Midgley created tetraethyl lead, named Ethyl gasoline. In its first 25 years, it saved a billion barrels of oil, and it became an essential component of aviation fuel.

Midgley tackled another task in 1928, creating the nontoxic, nonflammable refrigerant Freon. In a famous presentation before the American Chemical Society in 1930, Midgley exhaled a lungful of Freon vapors onto a lit candle. The flame went out, proving Freon was neither poisonous nor flammable.

Although the environmental impacts of lead gasoline and Freon were not immediately apparent, both discoveries were important achievements. Midgley's other accomplishments include creating a process for extracting bromine from seawater, developing natural and synthetic rubbers, and acquiring 117 patents.

Photo credit: Courtesy of The National Park Service, Tuskegee Institute N.H.S

George Washington Carver

Cosmetic and Process of Producing the Same; Paint and Stain and Process of Producing the Same

Patent Nos. 1,522,176; 1,541,478

Born ca. 1864
Died January 5, 1943

Inducted in 1990

Agricultural chemist George Washington Carver developed crop-rotation methods for conserving nutrients in soil and discovered hundreds of new uses for crops such as the peanut and sweet potato.

Born of slave parents in Diamond Grove, Missouri, Carver received his early education in Missouri and Kansas. He gained acceptance to Simpson College in Indianola, Iowa, in 1887 and in 1891, transferred to Iowa Agricultural College (now Iowa State University) where he earned a B.S. in 1894 and an M.S. in 1897. Later that year Booker T. Washington, founder of Tuskegee Institute, convinced Carver to serve as the school's director of agriculture. At Tuskegee, Carver developed his crop rotation method, which alternated nitrate-producing legumes such as peanuts and peas with cotton, which depletes soil of its nutrients.

Following Carver's lead, southern farmers began planting peanuts one year and cotton the next. Although the peanuts were used to feed livestock, large surpluses quickly developed. Carver developed 325 different uses for the extra peanuts–from cooking oil to ink. When he discovered that the sweet potato and the pecan also enriched depleted soils, Carver found uses for these crops as well.

Upon his death, Carver contributed his life savings to establish a research institute at Tuskegee. His birthplace was declared a national monument in 1953.

Photo Credit: Museum Boerhaave

Willem Einthoven

Receiving of Wireless Signals

Patent No. 1,592,628

Born May 21, 1860
Died September 28, 1927

Inducted in 2008

Willem Einthoven designed the first instrument that accurately recorded the electrical activity of the heart and produced the first reliable electrocardiogram. His string galvanometer enabled detection of abnormal heart function, dramatically advancing the study of heart disease.

Born in Java, Einthoven was the son of a physician. He earned his Ph.D. in medicine at the University of Utrecht in 1885 and was appointed Professor of Physiology at the University of Leiden that same year. He did important work on the function of bronchial muscles and in optics before turning his attention to improving A.D. Waller's electrocardiogram, which was unreliable and required complex mathematical corrections. Einthoven placed a fine quartz wire under tension in a magnetic field. When exposed to an electrical current, the wire moved in response to the charge and Einthoven photographed the movements on a reel of film. The string galvanometer benefited studies of the nerves and muscles, as well as the heart.

Einthoven later studied heart sounds, retinal currents, and acoustics. His laboratory at Leiden was a magnet for scientists from around the world. In 1924, Einthoven was awarded the Nobel Prize in Physiology or Medicine for his discovery of the mechanism of the electrocardiogram.

Photo credit: Courtesy of Macomber, Inc.

Stanley Macomber

Structural Unit

Patent No. 1,651,032

Born November 26, 1887
Died May 15, 1967

Inducted in 2011

Stanley Macomber was born in Ida Grove, Iowa, receiving his early education locally and at Annapolis Naval Preparatory Academy. He received a B.S. in civil engineering from Iowa State College in 1908. In 1912, he became city engineer for Centralia, Washington, where he published papers on his civil engineering projects. He moved to Canton, Ohio, in 1915 for a position in metal lumber sales with Berger Manufacturing Company.

In November 1919, Macomber called an organizational meeting of leading structural steel fabricators, forming the American Institute of Steel Construction and serving on the first board of directors. In June 1928, he was a charter member of the Steel Joist Institute.

When Macomber took a position with National Pressed Steel Company of Massillon, Ohio, in 1919, he perfected his idea for an open web joist floor system to serve as a freeway for pipes, conduits, and ductwork. In 1923, Macomber filed his first patent for the open web joist and formed the Massillon Steel Joist Company. The company relocated to Canton in 1925, and the name was changed to Macomber Steel Company. Macomber is known as the "father of open web joist construction."

Photo credit: Brannock Device Company Records, Archives Center, National Museum of American History, Smithsonian Institution

Charles F. Brannock

Foot Measuring Device

Patent No. 1,682,366

Born May 16, 1903
Died November 22, 1992

Inducted in 1992

Charles Brannock invented the Brannock Device® for measuring feet, improving upon the traditional methods of foot measurement.

Born in Syracuse, New York, Brannock attended Syracuse University. Working as a salesman at his father's shoe store, he began designing a device to improve traditional size-sticks used to measure feet in the shoe industry. He developed the Brannock Device, which consists of a series of graduated measurements along the base plate for both men and women's foot measurements. By observing a foot on this base plate, a shoe salesperson could read from the graduated markings the shoe size—measuring the length and width as well as from the heel to the ball of the foot—that would best fit the customer.

By the time his first patent was issued, Brannock founded the Brannock Device Company in 1925 to produce and sell his invention. The device proved to be a success in the shoe retail business, and during the 1930s and 1940s, various military branches used the Brannock Device to ensure enlisted men were equipped with properly sized footwear.

Little has changed from the initial design of the Brannock Device, and it continues to be the standard tool employed for foot measurements throughout the footwear industry.

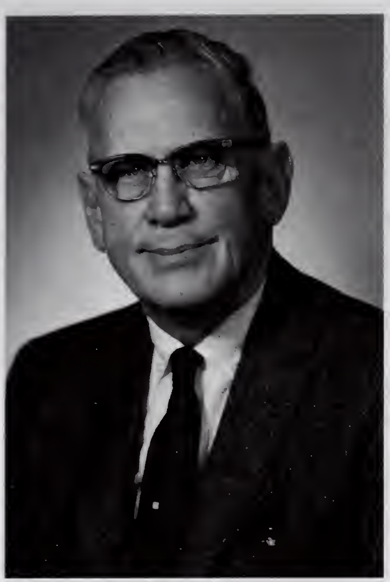


Photo credit: Courtesy of 3M Co.

Richard Gurley Drew

Adhesive Tape

Patent No. 1,760,820

Born June 22, 1899
Died December 14, 1980

Inducted in 2007

Richard Drew invented masking tape and transparent cellophane tape, the first modern pressure sensitive tapes.

Born in St. Paul, Minnesota, Drew attended the University of Minnesota before working as a lab technician for 3M, then a sandpaper manufacturer. While delivering trial batches of sandpaper to the local auto body shop for testing, he noticed painters having difficulty masking car parts because the paint peeled off when the tape was removed. Drew devised a tape of cabinetmaker's glue and treated crepe paper. Automakers found the tape ideal for masking off areas during auto body painting and immediately began to place orders. The tape was marketed as Scotch® masking tape in 1925.

Five years later, Drew developed the transparent Scotch® cellophane tape. The invention was a major asset during the Great Depression. It became a popular tool for repairing ripped, torn, or broken items rather than buying new ones. Books, window shades, toys, clothing, and even paper currency were mended with cellophane tape.

Drew's tape innovations were the first in a family of 900 pressure-sensitive tapes used worldwide in office, medical, electrical, construction, and other applications. 3M remains the leading manufacturer of pressure-sensitive tapes in the world.

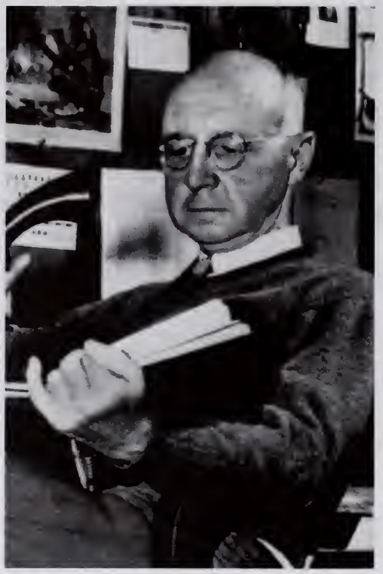


Photo credit: Birds Eye Foods

Clarence Birdseye

Method of Preparing Food Products

Patent No. 1,773,079

Born December 9, 1886
Died October 7, 1956

Inducted in 2005

Clarence Birdseye improved the nation's diet and created a new industry based on his innovative food preservation processes.

During an expedition to Labrador, a young Birdseye observed native fishermen freezing their catch by throwing it on surface ice. The fish were frozen quickly in the frigid air, and Birdseye recognized that the speed of freezing prevented frost damage. He later observed that slowly frozen food created large ice crystals, whereas rapid freezing retained close to the original flavor and texture.

In 1924 Birdseye launched General Seafoods to sell frozen fish. Two years later he introduced a quick freeze double-plate machine and in 1930, the first retail frozen products were introduced to consumers in Springfield, Massachusetts. To help sales efforts, Birdseye created and leased special display cases which showcased the products. He is known for developing many other pioneering processes. Today, Birds Eye Foods continues Birdseye's legacy of innovation in frozen food.

Born in Brooklyn, New York, Birdseye studied at Amherst College before working at numerous biological departments within the U.S. government. He is credited with increasing the quality of the American diet by providing high quality foods for long-term preservation without drying, pickling or canning.

Photo credit: Special Collections Department, University of Utah Libraries

Philo Taylor Farnsworth

Television System

Patent No. 1,773,980

Born August 19, 1906
Died March 11, 1971

Inducted in 1984

Philo Taylor Farnsworth's electronic inventions made possible today's TV industry, the TV shots from the moon, and satellite pictures. Born in Beaver, Utah, Farnsworth, while still in high school, delved into the molecular theory of matter, electrons, and the Einstein theory. In 1924 he enrolled in Brigham Young University, but left at the end of his second year.

In 1926 Farnsworth joined the Crocker Research Laboratories in San Francisco. At the age of 20 he produced the first all-electric television image. Crocker Research Laboratories was reorganized as Television Laboratories, Inc., and was renamed Farnsworth Television Inc., of California.

Farnsworth's television patents covered scanning, focusing, synchronizing, contrast, controls, and power. He also invented the first cold cathode ray tubes, the first simple electronic microscope, used radio waves to get direction (later called radar), and black light for seeing at night. During the 1960s he worked on special-purpose TV, missiles, and peaceful uses of atomic energy. He also worked on a nuclear fusion process to produce clean, virtually unlimited energy.

At his death, he held more than 300 U.S. and foreign patents. In 1983 he was honored by the U.S. Postal Service with a stamp bearing his portrait.

Photo credit: Courtesy of AT&T Archives and History Center

Warren Marrison

Frequency Control System

Patent No. 1,788,533

Born May 21, 1896
Died March 27, 1980

Inducted in 2011

In the early 20th century, as telephone wires carried more messages and radio broadcasting matured, maintaining stable electrical frequencies and devising means to monitor frequencies became critical technical problems. Marrison, a telecommunications engineer at Bell Laboratories, was searching for more reliable frequency standards.

In 1921 Marrison went to Harvard University, where he earned an M.A., and soon joined the Western Electric Company in New York. He transferred in 1925 to Bell Labs, where he began work on the development of frequency standards for radio transmission. Building on earlier work in piezoelectricity, he developed a very large, highly accurate clock based on the regular vibrations of a quartz crystal in an electrical circuit. But, at that time there was no way of counting and displaying the number of vibrations as the frequency was too high.

In 1927 Marrison succeeded in dividing the frequency electronically until it was low enough to drive a synchronous motor. Although his purpose was to determine the frequency accurately by counting the number of vibrations that occurred in a given time, he had incidentally produced the first quartz crystal clock. The results were sufficiently encouraging for him to build an improved version the following year, specifically as a time and frequency standard. During the 1940s, time standard laboratories throughout the world switched from mechanical clocks to quartz.

Photo credit: Courtesy of University of Notre Dame Archives

Rev. Julius Arthur Nieuwland C.S.C.

Vinyl Derivatives of Acetylene and Method of Preparing the Same

Patent No. 1,811,959

Born February 14, 1878
Died June 11, 1936

Inducted in 1996

The inventor of the first synthetic rubber, neoprene, was Julius Arthur Nieuwland. Nieuwland was a professor at the University of Notre Dame and a priest of the Congregation of the Holy Cross. Born of Flemish parents in Hansbeke, Belgium, he immigrated with his family to South Bend, Indiana. He graduated from Notre Dame in 1899, studied for the priesthood and was ordained in 1903, and received his Ph.D. from Catholic University in 1904.

He taught botany at Notre Dame, and in 1918 he became a professor of organic chemistry. His discovery of a reaction between acetylene and arsenic trichloride led to the development of the poison gas lewisite. His work with acetylene also led him into a collaboration with scientists from DuPont. He found that if monovinylacetylene were treated with hydrogen chloride and the resulting chloroprene polymerized, neoprene would result.

Eventually, neoprene was put on the market in 1932 by DuPont under the name Duprene. Neoprene was considered superior to rubber in many ways such as in its resistance to sunlight, abrasion, and temperature extremes. These properties made it popular for many uses such as electrical cable insulation, telephone house-to-house wiring, many moulded, extruded, and sheet products, rug backings, and roofing.

Photo Credit: Link Simulation & Training

Edwin A. Link

Combination Training Device for Student Aviators and Entertainment Apparatus

Patent No. 1,825,462

Born July 26, 1904
Died September 7, 1981

Inducted in 2003

Edwin A. Link had an impact on aerospace and hydrospace few will match. His contributions to aviation are unparalleled. He invented the first successful flight simulator, which redefined how pilots were trained. He spent the second half of his life immersed in oceanographic exploration, creating innovative ways to explore the oceans.

A native of Huntington, Indiana, Link became a skilled aviator in the 1920s at the same time that he worked in his father's organ factory. He realized there needed to be a way to train pilots effectively and safely on the ground. Using parts and techniques from the organ, he built a device that could simulate the motions of an airplane. Less than two decades later, his Link Trainer, known as the "Blue Box," was essential in training pilots during World War II. The Federal Aviation Administration now allows pilots to be certified to fly designated aircraft based solely on training in a simulator.

Besides aviation, underwater exploration intrigued Link. He designed and developed numerous devices to aid scientific research, including Johnson-Sea-Link Class submersibles. Through this work, he created access to another ten percent of the earth's surface.

Photo credit: Archives of Children's Hospital, Boston, Massachusetts

Philip Drinker

Respiration Apparatus

Patent No. 1,834,580

Born December 12, 1894
Died October 19, 1972

Inducted in 2007

Philip Drinker invented the first iron lung, a respirator that has helped save lives, especially those afflicted with polio and other cases of paralysis.

Born in Haverford, Pennsylvania, Drinker graduated from Princeton in 1915. Hired by Harvard as an instructor of industrial hygiene, Drinker was subsequently employed in Harvard's new School of Public Health in 1923, where he developed and patented the first iron lung.

The invention stemmed from research on methods of resuscitation for victims of gas poisoning and electric shock. Early models of the respirator encapsulated the patient's entire body, while later ones provided an opening through which the head could rest outside of the chamber. Fitting a collar around the neck of the patient ensured the chamber itself remained airtight. A second patent in 1933 improved on the original by providing an apparatus in which the doctor or nurse could insert their hands to bathe the patient or change bedding.

The first such artificial respirator was put into use in 1928 to assist the breathing of a girl who suffered from infantile paralysis. By the 1930s, in the wake of an outbreak of polio, the respirator was in high demand in hospitals throughout the nation.

Photo credit: Property of AT&T Archives. Reprinted with permission of AT&T

Herman A. Affel

Concentric Conducting System

Patent No. 1,835,031

Born August 4, 1893
Died October 13, 1972

Inducted in 2006

Herman Affel and Lloyd Espenschied invented coaxial cable at AT&T Bell Telephone Laboratories in 1929. The coaxial cable opened a wide spectrum of frequencies for long distance telephone service, making it possible to carry thousands of simultaneous phone calls on long distance circuits.

Affel was born in Brooklyn, New York and studied electrical engineering at the Massachusetts Institute of Technology. As a consultant to Bell Labs, Affel worked with Espenschied devising efficient means to carry high frequencies needed for broadband communications systems. Affel and Espenschied created a transmission system using a coaxial conductor, consisting of two concentric cylinders of conducting material separated by air. This structure reduced frequency losses and prevented outside interference.

Broadband coaxial cable created a higher capacity for local and long distance circuits. During his career at Bell Labs, Affel worked with other engineers to combine coaxial cable with microwave relays, making high-volume transcontinental telephone and television transmission signals possible. He earned several other patents for electronic devices, including advanced transmitters and innovative antennas.

Photo credit: Property of AT&T Archives. Reprinted with permission of AT&T

Lloyd Espenschied

Concentric Conducting System

Patent No. 1,835,031

Born April 27, 1889
Died June 21, 1986

Inducted in 2006

In 1929, Lloyd Espenschied and Herman Affel invented coaxial cable at the AT&T Bell Telephone Laboratories. This technological breakthrough allowed for long distance telephone service, making it possible to carry thousands of simultaneous phone calls on long distance circuits.

Coaxial cable is a copper cable lined with two concentric cylinders of conducting material. It is widely used by cable TV and telephone companies for homes and businesses. Its effective transmission of high frequencies over long distances is the industry standard used in business and corporation Ethernets.

Espenschied also contributed to the development of wire distribution of radio programming used in network radio. He patented a collision avoidance system using reflected waves for railroad trains, and later applied similar techniques for a radio altimeter for airplanes.

Born in St. Louis, Missouri, Espenschied studied at the Pratt Institute, graduating in 1909. He held over 130 patents, and his extensive contributions to the field of telecommunications earned him the Institute of Radio Engineers' Medal of Honor.

Photo credit: Sun Company, Inc.

Eugene Houdry

Process for the Manufacture of Liquid Fuels

Patent No. 1,837,963

Born April 18, 1892
Died July 18, 1962

Inducted in 1990

Eugene Houdry discovered a method for cracking low-grade crude oil into high-test gasoline, developed a process for producing synthetic rubber in World War II, and invented the catalytic converter for cleaning automobile exhaust. Born in France, Houdry studied mechanical engineering at the Ecole des Arts et Metiers in Paris.

He served in the French Army as a lieutenant in the tank corps in World War I. After the war, Houdry invented a method for catalytically cracking low-grade crude oil. The process revolutionized the production of gasoline and enabled refineries to produce twice as much high-quality fuel per barrel of oil than the previous method. In 1930 Houdry moved to the United States, where Vacuum Oil and the Sun Oil Company provided financial backing for his work and the Houdry Process Corporation.

During World War II, he returned briefly to France to adapt his cracking process to the production of high-octane aviation gasoline. Houdry also contributed to the war effort by developing a single-step butane dehydrogenation process for producing synthetic rubber.

After the war Houdry formed a company called Oxy-Catalyst and turned his attention to the reduction of health risks from automobile and industrial exhaust. His catalytic muffler, patented in 1962, greatly reduced the amount of carbon dioxide and unburned hydrocarbons. Today, the device is standard on all American cars.

Photo Credit: Courtesy San Diego Aerospace Museum

Leroy Grumman

Retractable Landing Gear for Airplanes

Patent No. 1,859,624

Born January 4, 1895
Died October 4, 1982

Inducted in 2003

Leroy Grumman invented a unique folding-wing mechanism that advanced the safety and versatility of carrier-based naval aircraft, and more than doubled the number of planes that a carrier could hold. Today's folding wings still reflect his influence. Grumman also designed more reliable, retractable landing gear for amphibious aircraft.

Grumman, born on Long Island, New York, established the Grumman Aircraft Engineering Corporation in 1929. In 1932, former Navy pilot Grumman obtained a Navy contract for twenty-seven FF-1 fighters, the first carrier-based plane with fully retractable gear that was able to exceed 200 mph in level flight. By the middle of WWII, Grumman was the Navy's top aircraft supplier, producing in 1943 the most military aircraft ever built in one plant in a single month. Well-known aircraft included Wildcat, Avenger, and Hellcat. His company manufactures reliable, rugged aircraft to this day, part of the Northrop Grumman Corporation since 1994.

At a labor conference in 1942, Rear Admiral John McCain lauded the company, saying "The name Grumman on a plane or part has the same meaning to the Navy that 'Sterling' on silver has to you." Highly respected within the industry, Grumman received the Presidential Medal of Merit in 1945.

Photo credit: The BFGoodrich Company

Waldo L. Semon

Synthetic Rubber-Like Composition & Method of Making Same; Method of Preparing Polyvinyl Halide Products

Patent No. 1,929,453; 2,188,396

Born September 10, 1898
Died May 26, 1999

Inducted in 1995

In 1926, Waldo Semon, newly employed at The BFGoodrich Company in Akron, Ohio, decided to pursue a dubious project. He began trying to dissolve an undesirable material called polyvinyl chloride (PVC) to create an adhesive for bonding rubber to metal. He never succeeded in creating the adhesive, but by heating PVC in a solvent, he discovered a substance that was both flexible and elastic. At first no one knew what to make of it, but decades later PVC has become the world's second-best selling plastic.

Born in Demopolis, Alabama, Semon entered the University of Washington determined to be a chemist. He graduated cum laude in 1920, then received his Ph.D. in chemistry in 1923. After a short period as an instructor at the university, Semon joined BFGoodrich. While research director at BFG, Semon provided the technical leadership for the discovery of three major new families of polymeric materials: thermoplastic polyurethane, synthetic "natural" rubber, and the first oil-resistant synthetic rubbers.

Following his retirement from BFG in 1963, Semon served as a research professor at Kent State University. During his lifetime, Semon was awarded 116 U.S. patents.

Photo credit: Lear Archives, Reno, Nevada

William P. Lear

Radio Apparatus

Patent No. 1,944,139

Born June 26, 1902
Died May 14, 1978

Inducted in 1993

Though his name is most often associated with corporate jet airplanes, William Lear earlier made his mark in car radios and by inventing the eight-track tape player. Born in Hannibal, Missouri, Lear attended public school in Chicago through the eighth grade. At age 16 he joined the Navy, where he learned radio electronics. Following World War I he took up flying.

An early Lear design, a practical car radio, launched the Motorola Company. RCA purchased a radio amplifier design of Lear's, a universal unit usable in their entire line. Lear designed the eight-track player in the 1960s. Lear began designing navigational aids for aircraft in the 1930s and under the names Lear and LearAvia Corporation filled more than $100 million in defense orders during World War II. After the war, he developed a lightweight automatic pilot. In 1962 he sold his interest in Lear, to form Learjet, which became the leading supplier of corporate jets within five years.

After Learjet he devoted his energies to development of an antipollution steam engine. In the 1970s his aircraft designs included the Canadair Challenger and the Lear Fan, an airplane built entirely from composites. Lear died during development of the Lear Fan, and although there were a number of advance orders it was never put into production.

Photo credit: AIP Emilio Segrè Visual Archives

Ernest Orlando Lawrence

Method and Apparatus for the Acceleration of Ions

Patent No. 1,948,384

Born August 8, 1901
Died August 27, 1958

Inducted in 1982

Ernest Orlando Lawrence invented the cyclotron, a device that greatly increased the speed with which projectiles could be hurled at atomic nuclei. Without it and related instruments, most of the advancements in nuclear physics made in the last 50 years could not have occurred.

Born in Canton, South Dakota, Lawrence graduated from the University of South Dakota in 1922 then went to Yale University, where he obtained his Ph.D. in physics in 1925. In 1927 he joined the faculty of the University of California.

Lawrence built his first cyclotron in 1930. Unlike other devices, which attempted to give charged particles one tremendous push, Lawrence's device moved protons in a widening spiral, imparting more energy to them with each spin, until they finally shot out of the instrument.

In 1939 Lawrence was rewarded for his work with the Nobel Prize in Physics.

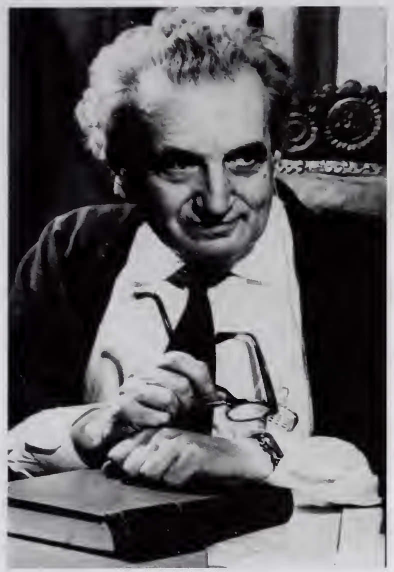


Photo Credit: Courtesy San Diego Aerospace Museums

Theodore von Kármán

Process and Apparatus for Making Aerial Propellers

Patent No. 1,962,794

Born May 11, 1881
Died May 6, 1963

Inducted in 2003

Theodore von Kármán greatly influenced the development of high speed aircraft by applying his theory of the Vortex Trail, the first theory of supersonic drag. His ingenuity allowed him to develop a more aerodynamic structure on planes and wings.

Born in Budapest, von Kármán attended the Royal Technical University and the University of Göttingen. At Göttingen, he discovered ground-breaking theories in aerodynamics. Upon moving to America in 1930, he was appointed Director of the Guggenheim Aeronautical Lab at the California Institute of Technology, focusing on the mathematical analysis of aerodynamics, hydrodynamics, and thermodynamics. He possessed an innate ability to create simple formats and apply them to supersonic flight.

He significantly influenced future aerodynamic designs of airships, airplanes, and rockets with his Law of Turbulence. He created prototypes for the early rocket engines such as Polaris, Minutemen, Poseidon, and Tomahawk intercontinental ballistic missiles.

Hailed as one of the true geniuses of the world, he constantly defied conventional boundaries, creating new theories while defying old ones. His numerous awards included the National Medal of Science and the Wright Brothers Memorial Trophy.

Photo Credit: Eastman Kodak Company

Leopold Godowsky, Jr.

Color Photography

Patent No. 1,997,493

Born May 27, 1900
Died February 18, 1983

Inducted in 2005

Leopold Godowsky, Jr. and Leopold Mannes, affectionately known by colleagues and friends as "God and Man," were professional musicians who performed together and who enjoyed photography as a hobby.

As a classical concert violinist, Godowsky, Jr. performed as soloist and as first violinist of the San Francisco and the Los Angeles Symphonies. He also enrolled at the UCLA to study physics and chemistry.

In 1916 the two Leopolds started experimenting with the complex methods of producing color images, using filters of various colors. For 14 years they worked in their kitchens and bathrooms, often in darkness, and measured film developing times by whistling the last movement of Brahms' C-minor Symphony at a metronomic pace of two beats per second. Their passionate interest in developing their innovative color process made it possible for Kodachrome® color film to become a commercial success. Godowsky, Jr. continued research into the 1950s, improving the process for Kodak in his laboratory in Westport, Connecticut.

Despite Godowsky's success as an inventor, he considered music, especially playing chamber music, often with illustrious musicians of the time like Heifetz and Piatigorsky, his greatest passion in life.

Photo Credit: Eastman Kodak Company

Leopold Mannes

Color Photography

Patent No. 1,997,493

Born December 26, 1899
Died August 11, 1964

Inducted in 2005

Leopold Mannes' passion for photography led to his work creating Kodachrome® film. Mannes and Leopold Godowsky, Jr. met as teenagers. Fascinated by the popular Brownie cameras, both longed for a way to take color photographs, experimenting with the process.

Mannes went on to study music at Harvard, earning a Pulitzer and a Guggenheim Fellowship for composition. After he and Godowsky, Jr. became musicians, they continued their photographic collaboration. Their search for financial support led them to Eastman Kodak, where they were assigned a team of researchers. While working in darkness, Mannes and Godowsky, Jr. measured film-developing times by whistling the last movement of Brahms' C-minor Symphony.

In 1936, Kodachrome® film was introduced. The availability of a robust, practical color film triggered a cultural, artistic, and commercial revolution as amateur and professional photographers embraced the new technology.

After inventing Kodachrome®, Mannes remained in music as a pianist and composed several musical scores. He served as president of the Mannes College of Music founded by his parents, and he served as a judge in music competitions, including the first Van Cliburn International Piano Competition. Born in New York City, he studied music at Juilliard and Harvard.

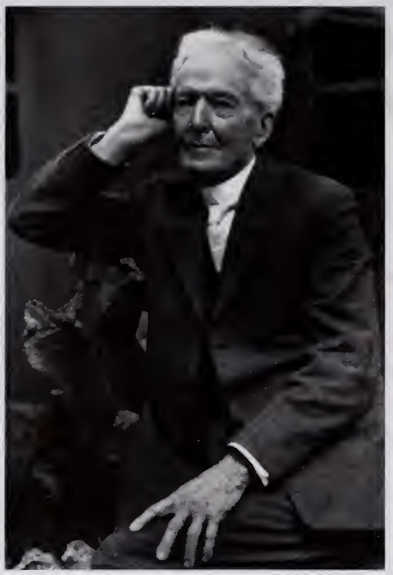


Photo credit: Luther Burbank Home & Gardens

Luther Burbank

Peach

Plant Patent No. 15

Born March 7, 1849
Died April 11, 1926

Inducted in 1986

Luther Burbank developed more than 800 strains and varieties of plants, including 113 varieties of plums and prunes, 10 varieties of berries, 50 varieties of lilies, and the Freestone peach. Born in Lancaster, Massachusetts, Burbank received only an elementary education.

At 21 he began a 55-year plant breeding career. In 1871 he developed the Burbank potato, which was introduced in Ireland to combat the blight epidemic. He sold the rights to the Burbank potato for $150, which he used to travel to Santa Rosa, California. In Santa Rosa, he established a nursery garden, greenhouse, and experimental farms that have become famous throughout the world. Burbank carried on his plant hybridization on a huge scale. At any one time he maintained as many as 3,000 experiments involving millions of plants. The Plant Patent Act of 1930 amended U.S. patent law to permit protection of new and distinct varieties of asexually reproduced plants, other than tuber-propagated plants.

This legislation resulted from the growing awareness that plant breeders had no financial incentive to enter plant breeding because they could not exercise control over their discoveries. Consequently, Burbank received his plant patents posthumously.

Photo Credit: Courtesy MIT Museum

Vannevar Bush

Amplifying System

Patent No. 2,032,253

Born March 11, 1890
Died June 28, 1974

Inducted in 2004

In 1931, Vannevar Bush completed work on his most significant invention, the differential analyzer, a precursor to the modern computer. It used electrical motors to drive shafts and gears that represented terms in complex equations, and was invaluable to scientists and engineers in fields as diverse as ballistics, acoustics, and atomic physics. The differential analyzer significantly reduced the time and effort required to carry out such calculations and opened the eyes of many observers to the enormous possibilities of computers.

Bush was born in Everett, Massachusetts, and earned B.S. and M.S. degrees in engineering from Tufts University before completing his Ph.D. in engineering at MIT in 1916. After performing acoustic research for the Navy during World War I, Bush joined the MIT faculty, becoming dean of the school of engineering in 1932. From 1938 to 1955, Bush was president of the Carnegie Institution in Washington. During World War II, he became director of the Office of Scientific Research and Development, which oversaw all defense research and development, including the development of radar and the atomic bomb. After World War II, Bush played an important role in the federal government's financial support of basic research, including the establishment of the National Science Foundation. Bush may be best remembered, however, for his prescient, influential 1945 essay "As We May Think," in which he elaborated a vision that prefigured the development of hypertext and other elements of the World Wide Web.

Photo Credit: National Air and Space Museum, Smithsonian Institution (SI Neg. No. 76-19205)

Paul Kollsman

Level Flight Indicator

Patent No. 2,036,581

Born February 22, 1900
Died September 26, 1982

Inducted in 2003

In 1928, Paul Kollsman forever changed the way pilots would fly. By introducing the first accurate barometric altimeter, an instrument used to measure the altitude by calculating barometric pressure, "flying on the gauges" became possible. In 1929, the first blind flight was made using the altimeter as a guide through the sky. Kollsman's altimeter with a barometric setting display, which is commonly called the Kollsman Window, is still integral to aircraft flight.

Paul Kollsman was born and educated in Germany, studying science and technology before he immigrated to America in 1923 in hopes of selling a radical new automotive engine. He was introduced to altimeters during employment with the Pioneer Instrument Company. Working from his attic in 1928 he developed an altimeter with unprecedented accuracy. The Navy purchased 300, launching Kollsman Instrument Company.

Kollsman acquired more than a hundred patents, and the altimeter is considered one of the major milestones in aviation. A man of many interests, Kollsman was active in the mining industry and was granted many patents for his work in converting seawater to fresh water and a patent for a slip-resistant surface for bathtubs and showers.

Photo credit: Courtesy of Phillips Screw Company

Henry Phillips

Screw

Patent No. 2,046,343

Born 1890
Died 1958

Inducted in 2011

The significance of the crosshead or Phillips screw lies in its self-centering property. In 1933, Henry Phillips purchased the rights to a socket screw and redesigned the screw with a cruciform recess. Unlike a traditional slot screw which required a person to simultaneously center the screw in its hole, steady the screwdriver in the slot, and then use the screwdriver to turn the screw, the Phillips screw's cruciform head sat firmly on the screwdriver with no need to center the screw in the hole.

As automobiles and other products came to be assembled on moving assembly lines in the 1920s, it soon become apparent to engineers that mass production could be greatly improved by developing a self-centering screw that would work with power tools.

Over the next few years, Phillips filed several patents for this design and formed the Phillips Screw Company. Phillips initially encountered difficulty in convincing manufacturers to produce his new screw. He persisted and finally persuaded the American Screw Company to license and manufacture his innovation. American Screw convinced General Motors to test Phillips screws on its assembly line, and GM used the new fastener to manufacture its 1936 Cadillac. It helped speed production, and was rapidly adopted by other Detroit automakers. By 1940, 85% of the screw manufacturing companies had secured a license from Phillips to produce his design.

Photo credit: Courtesy of Associated News Photographic Services

Semi Joseph Begun

Electromagnetic Talking Device; Electromagnetic Talking Machine

Patent Nos. 2,048,487; 2,048,488

Born December 2, 1905
Died January 5, 1995

Inducted in 1998

Semi Joseph Begun was a pioneer of magnetic recording. Begun was born in Danzig, Germany. He graduated in 1929 from the Institute of Technology in Berlin. There, he became interested in magnetic recording. His doctoral thesis and his book were firsts in this field, both entitled Magnetic Recording. In 1934, he built the first tape recorder for broadcasting.

Begun immigrated to the U.S. in 1935. He joined the Brush Development Company of Cleveland in 1938. During World War II, as a member of the National Defense Research Committee (NDRC), he promoted the development of magnetic recording. One application was the Black Box aircraft recorder used to investigate aircraft accidents. After the war, Begun continued developing recording media, coating paper and plastic tape with ferromagnetic powders. He developed the Sound Mirror, the first consumer tape recorder, the Mail-A-Voice, which magnetically recorded on one side of a paper disk for letter correspondence, and a sourcing agreement for magnetic tape with 3M that turned into a billion dollar product line.

In 1971, Begun founded Auctor Associates, a technology-oriented consulting firm. His many honors include the Presidential Certificate of Merit from President Truman for his work in NDRC.

Photo credit: Property of AT&T Archives, Reprinted with permission of AT&T

Robert R. Williams

Process for Obtaining Vitamins

Patent No. 2,049,988

Born February 16, 1886
Died October 2, 1965

Inducted in 1991

Robert R. Williams developed ways to synthesize vitamins to fight malnutrition and vitamin-deficiency diseases. Born in India, the son of Baptist missionaries, Williams witnessed the suffering caused by malnutrition. When he was 10, Williams returned with his family to the United States where he attended school in Ottawa, Kansas. Williams earned his B.S. (1907) and an M.S. (1908) in chemistry from the University of Chicago.

Williams returned to the East to teach school in the Philippines while awaiting a job opening in the Manila Bureau of Science. There he began a 25-year search for a cure for beriberi. During World War I Williams was recalled to the Washington, D.C. Bureau of Science to work on war projects. To support his family, he took a job with the Bell Telephone Company in New York, where he would serve as chemical director for 20 years.

He conducted research in his spare time with the aid of grants and space provided by Columbia University and others. Williams isolated thiamine in crystalline form in 1933 and synthesized vitamin B1 in 1935. Williams was also instrumental in enriching flour and other cereal grains, wiping out the niacin and riboflavin deficiency common among underprivileged people.


Photo credit: Courtesy of the Beckman Heritage Center

Arnold O. Beckman

Apparatus for Testing Acidity

Patent No. 2,058,761

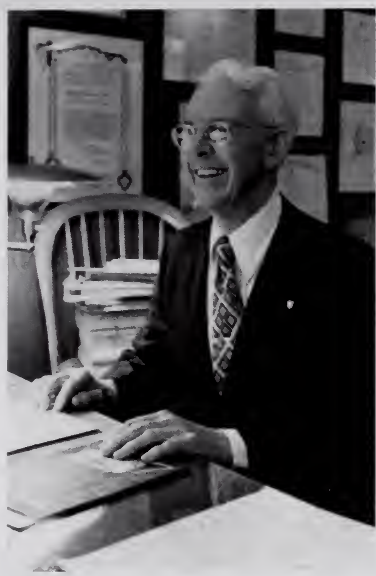
Born April 10, 1900
Died May 18, 2004

Inducted in 1987

Arnold O. Beckman invented a pH meter and the quartz spectrophotometer, an instrument which pioneered automatic chemical analysis. Born in Cullom, Illinois, Beckman received his B.S. in 1922 and M.S. in 1923 from the University of Illinois. He pursued further graduate studies at the California Institute of Technology and received his Ph.D. in 1928. He became an assistant professor there in 1929, resigning in 1940 to devote his time to the development and manufacture of instruments used in chemical laboratories and in chemical process control.

He founded Beckman Instruments, Inc., in 1935 with the development of the pH meter. In 1940 he developed the helical potentiometer, another precision electronic component, and the quartz spectrophotometer. In 1997, the company became Beckman Coulter, Inc., and today manufactures instrumentation and related scientific products used widely in medicine, science, industry, pollution control, education, space exploration, and many other fields.

Beckman founded the Instrument Society of America. The Arnold and Mabel Beckman Foundation has contributed substantially to the advancement of education and research. The foundation's philanthropy is reflected in the many medical and scientific institutions that bear the Beckman name.



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Harold Stephen Black

Wave Translation System

Patent No. 2,102,671

Born April 14, 1898
Died December 11, 1983

Inducted in 1981

Research engineer Harold S. Black revolutionized telecommunications by inventing systems that eliminated feedback distortion in telephone calls. Born in Leominster, Massachusetts, Black graduated from Worcester Polytechnic Institute in 1921; later he received an honorary doctorate in engineering from his alma mater. Following graduation Black joined Western Electric's West Street Labs, the forerunner of Bell Telephone Laboratories, in New York City. The major task confronting the lab at that time was the elimination of distortion.

After six years of persistence, Black conceived the principles and equations for his negative feedback amplifier in a flash while commuting to work aboard the ferry. Basically, the concept involved feeding systems output back to the input as a method of system control. Negative feedback had wider applications than transcontinental and transatlantic telecommunications, including industrial, military, and consumer electronics, weaponry, analog computers, and such biomechanical devices as pacemakers.

Black worked on a negative feedback system to aid the blind and deaf from 1966 until his death.

Photo credit: Courtesy of Griffith Laboratories

Lloyd Augustus Hall

Sterilizing Foodstuffs

Patent No. 2,107,697

Born June 20, 1894
Died January 2, 1971

Inducted in 2004

Lloyd Hall was a pioneer in the field of food chemistry, creating many of the preservative chemicals that are now used to keep food fresh without losing its flavor. His "flash-dried" salt crystals, introduced in the 1930s, combined the preservative effect of sodium chloride with the curative action of sodium nitrate and sodium nitrite. Far superior to any products then available, they helped to revolutionize the meatpacking industry.

Hall also introduced the use of antioxidants to prevent spoilage of fats and oils in bakery products. Later, Hall demonstrated that many spices and flavorings, such as ginger and cloves, rather than acting as preservatives as was commonly believed, actually exposed foods to various microbes. In response, he devised a special process known as the Ethylene Oxide Vacugas treatment to control the growth of molds and bacteria while maintaining appearance, taste, and aroma.

Lloyd Hall was born in Elgin, Illinois. He received a B.S. in pharmaceutical chemistry from Northwestern University in 1914 and completed graduate work at the University of Chicago. He performed the bulk of his research during his 34-year career at Griffith Laboratories. He held more than 100 patents and was awarded honorary doctorates from Virginia State University, Howard University, and the Tuskegee Institute.

Photo credit: Courtesy Owens Corning

Dale Kleist

Method and Apparatus for Strengthening Fibers

Patent No. 2,121,802

Born January 17, 1909
Died May 4, 1998

Inducted in 2006

An accidental discovery made by Dale Kleist was the crucial breakthrough needed for manufacturing insulation-quality glass fibers in commercial quantities, making the fiberglass used as insulation in buildings, stoves, refrigerators, and furnaces affordable.

Born in Newark, Ohio, Kleist studied at The Ohio State University before working as a researcher at Owens-Illinois Glass Company in 1932. Teaming with Games Slayter and Jack Thomas to create better glass technology, Kleist attempted to seal together architectural blocks by melting and spraying glass. Although Kleist was unsuccessful sealing the blocks, the errant spray of molten glass inadvertently formed tiny glass fibers.

Thomas helped Kleist refine the technique, known as the steam-blown process. In 1938 Owens-Illinois and Corning Glass jointly created a new company, Owens-Corning Fiberglas® Corporation, to make fiberglass products using the process, as well as other innovations created by Kleist, Thomas, and Slayter.

Today, Owens Corning is a five billion dollar global leader, manufacturing not just glass fiber insulation but also glass fiber reinforcements used in sports cars, boats, and bathroom fixtures.

Photo credit: Courtesy of Owens Corning

John H. Thomas

Method and Apparatus for Strengthening Fibers; Glass Wool and Method and Apparatus for Making Same

Patent Nos. 2,121,802; 2,133,236

Born September 19, 1907
Died September 17, 1991

Inducted in 2006

Jack Thomas, Dale Kleist, and Games Slayter invented the process for making glass fiber insulation in commercial quantities. Fiberglass insulation is used in buildings, stoves, refrigerators, and furnaces, and fiberglass reinforcements are used to strengthen plastic materials in a variety of products, including cars, boats, and bathroom fixtures.

Thomas was born in East St. Louis, Illinois. Studying at the University of Illinois, he earned his B.S. in 1931. Upon graduating, Thomas was hired by Slayter to research new ways to use glass at Owens-Illinois Glass Company. Thomas hired Kleist, a college student, to work on several projects, including architectural glass blocks.

While Kleist was attempting to spray molten glass for a project, tiny fibers formed. Thomas immediately realized the process could be used in the commercial production of fiberglass. Thomas refined the process, leading to what is known as the steam-blown process, patented by Kleist and Thomas. In 1938, Owens-Illinois and Corning Glass jointly created a new company, Owens-Corning Fiberglas® Corporation, to make fiberglass products using the Kleist-Thomas process, as well as other innovations created by the trio.

Photo credit: Courtesy of the Hagley Museum and Library

Wallace Hume Carothers

Diamine-Dicarboxylic Acid Salts and Process of Preparing Same; Synthetic Fiber

Patent Nos. 2,130,947; 2,130,948

Born April 27, 1896
Died April 29, 1937

Inducted in 1984

Wallace Hume Carothers spent only nine years at DuPont before his death. But in that time he made contributions to the theory of organic chemistry that led to the invention of polymeric materials such as nylon and neoprene, the first commercially successful synthetic rubber. Born in Burlington, Iowa, Carothers first studied accounting and secretarial courses then entered Tarkio College as a science student while simultaneously holding assistantships in English and commercial studies. After receiving a B.S., Carothers obtained his master's and doctorate degrees from the University of Illinois.

He joined DuPont in 1928 as head of fundamental research in organic chemistry. At DuPont, Carothers first worked on the polymerization of acetylene and its derivatives; this led to the development by other scientists of neoprene.

His most outstanding work involved the theory of linear polymerization, which he tested by synthesizing a large number of polymers structurally similar to cellulose and silk. This work culminated in the production of nylon, which is today used in a wide variety of applications. The invention of nylon marked the beginning of a new era of synthetic fibers.

Photo credit: Courtesy Owens Corning

Games Slayter

Glass Wool and Method and Apparatus for Making Same

Patent No. 2,133,236

Born December 9, 1896
Died October 15, 1964

Inducted in 2006

In the 1930s, Games Slayter, the driving force behind Owens Corning technology and innovation, envisioned a glass fiber material that was lighter and more refined than the then-current technology produced. With help from Dale Kleist and Jack Thomas, Slayter developed the method for the mass-production of affordable fiberglass and early applications of the new technology.

In 1931, Slayter, a chemical engineer, persuaded executives with the Owens-Illinois Glass Company to support his research into finding new uses for glass. Slayter, with Thomas and Kleist, worked on ways to produce glass fiber insulation. Once Kleist and Thomas invented the steam-blown process for making glass fibers, Slayter streamlined the process for mass-production and made significant improvements. He developed numerous applications for the glass fibers, including blowing wool insulation for homes. By the 1940s, Owens-Corning was also producing glass fiber reinforcements for plastic laminates, which found their way into aircraft, boats, and many other uses.

Slayter was born in Argos, Indiana, earning his B.S. from Purdue University in 1921. A prolific inventor, Slayter held more than 90 patents.

Photo credit: Renault Corporate Communications/ all rights reserved

Louis Renault

Locking Device for Vehicle Wheels

Patent No. 2,136,760

Born February 15, 1877
Died October 24, 1944

Inducted in 2006

Louis Renault, a Paris native, became one of France's most well known automobile manufacturers, building his first automobile in 1898 and establishing the Renault Motor Company.

Renault's first car, "Voiturette," possessed a three-speed transmission plus a reverse gear. Within a short time, Renault received more than a dozen orders for his new car. In 1899, Renault and two siblings founded the Renault Brothers Automobile Company, and by 1908, Louis Renault had full control of the business.

Renault's numerous patents revolutionized the automotive industry. Chief among his designs were hydraulic shock absorbers, the drum brake, and the turbocharger. His hydraulic shock absorber is still a common feature on automobiles today. Renault's other inventions included a transmission that transferred power and motion from the engine to the wheels through a series of gears without the use of chains or belts.

During the German occupation of France during World War II, Renault opted to stay in his country while his company was under German administration. When the Germans were driven out of France in 1944, Renault was accused of industrial collaboration with the Nazis. He died in prison while awaiting trial.

Photo credit: Westinghouse Electric Corporation

Vladimir Zworykin

Cathode-Ray Tube

Patent No. 2,139,296

Born July 30, 1889
Died July 29, 1982

Inducted in 1977

Most people think of television as a development of the mid-20th century. But as early as 1929 Russian inventor Vladimir Zworykin was demonstrating a system with all the features of modern picture tubes. Born in Murom, Russia, Zworykin's interest in electrical equipment began at a young age.

At the Imperial Institute of Technology, he experimented with a primitive cathode-ray tube, developed in Germany by Karl Ferdinand Braun. The lure of theoretical physics drew Zworykin to Paris in 1912 after he graduated with honors. In Paris, he studied X-rays under Paul Langevin. Arriving in the United States in 1919, he soon joined the staff at the Westinghouse laboratory in Pittsburgh.

On November 18, 1929, at a convention of radio engineers, Zworykin demonstrated a television receiver containing his "kinescope," a cathode-ray tube. That same year Zworykin joined the Radio Corporation of America (RCA) in Camden, New Jersey. As the director of their electronic Research Laboratory, he was able to concentrate on making critical improvements to his system. Zworykin's "storage principle" is the basis of modern TV.

1939-1954
Re-inventing
War and Peace

Massive government support for technological development characterized World War II (1939-1945). Inventions such as radar, the computer, and the atomic bomb grew out of government-run laboratories or private programs supported by federal funds. Following the war, the government continued to fund research in areas such as atomic physics, chemistry, and electronics. Private research led to the transistor, which opened up a new world of miniature electronics. The electron microscope provided new insights into this and other microcosms. The cost of these new technologies, however, was beyond the reach of most individual inventors, accelerating the trend toward large corporate and government laboratories. As new products flooded the market, the public began to associate company names—not inventors—with new products. Inventors lost their standing as heroes in the public imagination.

Photo credit: Courtesy of Abbott Laboratories

Ernest H. Volwiler

Thiobarbituric Acid Derivatives

Patent No. 2,153,729

Born August 22, 1893
Died October 3, 1992

Inducted in 1986

Ernest H. Volwiler, working with Donalee Tabern at Abbott Laboratories, discovered the general anesthetic Pentothal which has since played an outstanding role in improving the well-being of generations of patients. Born in Hamilton, Ohio, Volwiler attended Miami University of Ohio and received his A.B. in 1914. In 1916 he received an M.A. from the University of Illinois, followed by a Ph.D. in 1918. After earning his Ph.D., Volwiler joined Abbott Laboratories as a researcher.

After holding a number of positions, including director of research and president, he became chairman of the board of Abbott Laboratories International in 1959. Volwiler and Tabern discovered Pentothal in 1936 when seeking a substance which could be injected directly into the blood stream to produce unconsciousness. For three years the two men screened over 200 compounds, eventually arriving at a sulfur-bearing analogue of Nembutal. Induction was smooth, pleasant, free of muscle twitching, and notably lacking in delirium or frightening psychic effects. It could be used for minor procedures or for more prolonged procedures by being administered before ether.

Even today, Pentothal is the agent of choice all over the world for operations and related procedures.

Photo credit: Courtesy of Abbott Laboratories

Donalee L. Tabern

Thiobarbituric Acid Derivatives

Patent No. 2,153,729

Born January 27, 1900
Died December 31, 1974

Inducted in 1986

Donalee L. Tabern and Ernest Volwiler discovered the anesthetic Pentothal, one of the most important agents in modern medicine. Born in Bowling Green, Ohio, Tabern obtained three degrees from the University of Michigan between 1921 and 1924, including his Ph.D. in chemistry. He joined Abbott Laboratories in 1926 where he worked with Volwiler. His early work centered on sleep-producing drugs, examining the side effects and different uses for pre-operative sleep or anesthesia. This resulted in two of the company's classic products, Nembutal and Pentothal.

Pentothal was hailed because of its flexibility and effectiveness as a general anesthetic. Oral surgeons especially welcomed it and it became known as a "truth serum" for psychotherapeutic uses. Tabern was responsible for Abbott's pioneering work in radio pharmaceuticals.

Other areas in which he was involved were vasopressors, curare-like compounds, antimalarials, diuretics, antiseptics, and X-ray diagnostic agents. In 1946, he headed a special research department to develop the use of radioactive materials in biology and medicine. In 1948 Abbott became the first pharmaceutical company to supply radio pharmaceuticals to medical and research institutions.

Photo credit: ©Disney

Walt Disney

Art of Animation

Patent No. 2,201,689

Born December 5, 1901
Died December 15, 1966

Inducted in 2000

Walt Disney invented the multiplane camera to produce state-of-the-art animation. First used in the 1937 short film The Old Mill, the camera added depth and richness to animation scenes. Disney's early productions were all short films. Bothered by the flatness of animation, he invented the multiplane camera to film through several layers of drawings. The lens could focus on any one of the layers, creating a more dynamic final product. In 1937, Snow White and the Seven Dwarfs was the first full-length animated film to use the camera. It was a success, and Disney went on to create many more classics.

Born in Chicago, Disney also spent part of his childhood in Missouri. As a teenager during World War I, Disney was an ambulance driver in France. On his return, he worked as a commercial artist, eventually starting his own production company. Finding success with his films, Disney entered into television and family entertainment. The Disneyland theme park opened in 1955 in California, and before Disney's death, he created plans for Walt Disney World in Florida.

Throughout his career, Disney was honored for his work in animation and entertainment. These honors include Academy awards, Emmy awards, and in 1964, the Presidential Medal of Freedom.

Photo credit: Courtesy of Helmut Germer

H.M. Edmund Germer

Discharge Device; Metal Vapor Lamp

Patent Nos. 2,202,199; 2,182,732

Born August 24, 1901
Died August 10, 1987

Inducted in 1996

Edmund Germer's development of the fluorescent lamp and the high-pressure mercury-vapor lamp increased the efficiency of lighting devices, allowing for more economical lighting while producing less heat than incandescent light.

Germer was born in Berlin, the son of an accountant. He studied at the University of Berlin during the 1920s, earning a doctorate in lighting technology. His goal was to invent a light source with higher lumen output and lower energy consumption than the incandescent lamp. He co-founded the Rectron Company which worked on developing inert gas-glowing cathode rectifiers. After resigning as chief physicist, he became an independent inventor during the 1930s for companies such as Osram and Phillips. Both his fluorescent lamp and high-pressure mercury-vapor lamp were licensed to General Electric.

After World War II, Germer was invited by Engelhardt Industries of Newark, New Jersey to continue his research at Hanovia. Germer received the Frank P. Brown Medal from the Franklin Institute in 1954 for his fluorescent lamp. Between 1926 and 1955, he received over 100 patents.

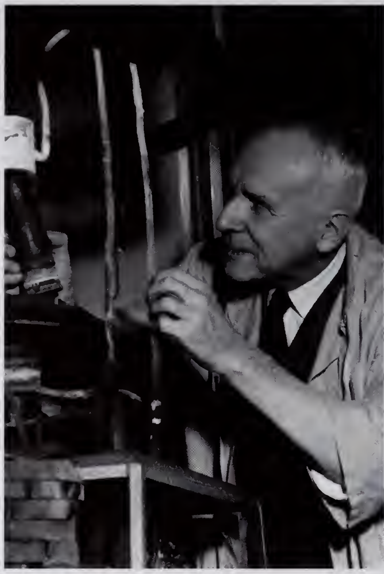

Photo credit: Oregon State University Archives

William J. Kroll

Method for Manufacturing Titanium and Alloys Thereof

Patent No. 2,205,854

Born November 24, 1889
Died March 30, 1973

Inducted in 2000

William Kroll invented a process to produce titanium and zirconium called the Kroll process. It remains the main method for extracting these metals from their ores.

Titanium was discovered in the late 1700s, but was difficult to obtain from its natural state. In 1932, Kroll combined titanium tetrachloride with calcium to produce ductile titanium. By 1938, he had produced 50 pounds of titanium. Later, the U.S. armed services became interested in titanium due to its strength and high melting point. Kroll went to work for the U.S. Bureau of Mines during World War II. In 1945, he investigated zirconium and was able to process it into a workable product. Shortly after, the U.S. Atomic Energy Commission became interested in zirconium due to its optimal nuclear and corrosion properties.

Kroll, born in Luxembourg, attended school at the Technische Hochschule in Germany. In 1940, he came to the U.S. to escape the Nazi invasion and worked for the Bureau of Mines in Albany, Oregon. He became a citizen in 1952. The uses for titanium and zirconium are diverse. Titanium's strength and light weight make it ideal for aerospace technology, sports equipment, and medical components. Zirconium is found in jet engines, radar equipment, fiber optics, and precision surgical equipment.

Photo credit: Courtesy of the Library of Congress [LC-USZ62-118118]

Katharine Burr Blodgett

Film Structure and Method of Preparation

Patent No. 2,220,860

Born January 10, 1898
Died October 12, 1979

Inducted in 2007

Working as a research assistant to Irving Langmuir, Katharine Blodgett experimented with monolayers, organic films only a single molecule thick, initiating a new scientific discipline and laboratory techniques still used today.

Born in Schenectady, New York, Blodgett earned her B.S. from Bryn Mawr College and her M.S. from the University of Chicago. As a research assistant to Langmuir at General Electric, Blodgett followed his discovery that a single water-surface monolayer could be transferred to a solid substrate. Years later, she found the process could be repeated to create a multi-layer stack of any thickness. The Langmuir-Blodgett technique, essentially unchanged since Blodgett's discovery in 1935, has found ever-widening uses in scientific research and practical applications ranging from solar energy conversion to integrated circuit manufacturing.

Blodgett furthered her work, creating multilayer antireflective coatings on glass, resulting in the world's first 100% transparent, or truly invisible, glass. Non-reflective glass eliminated distortion from reflected light in a wide variety of optical equipment including eyeglasses, telescopes, microscopes, and camera and projector lenses.

Blodgett was the first female scientist to be hired by GE and to earn a Ph.D. in physics from Cambridge University.

Photo credit: Courtesy of DuPont

Roy J. Plunkett

Tetrafluoroethylene Polymers

Patent No. 2,230,654

Born June 26, 1910
Died May 12, 1994

Inducted in 1985

Chemist Roy J. Plunkett discovered tetrafluoroethylene resin while researching refrigerants at DuPont. Known by its trade name Teflon®, Plunkett's discovery was found to be extremely heat-tolerant and stick-resistant. Since 1949, it has become an important coating for everything from satellite components to cookware.

Born in New Carlisle, Ohio, Plunkett graduated from Manchester College in 1932 with a B.A. in chemistry. He received his master's in 1933 and his Ph.D. in 1936, both from Ohio State University. Plunkett joined DuPont as a research chemist at the Jackson Laboratory in Deepwater, New Jersey in 1936, and less than two years later made his discovery of Teflon®. In 1939 he became a chemical supervisor for the manufacture of tetraethyl lead at the Chambers Works at Deepwater. He continued in administration at the Chamber Works until 1952. Later he directed operations in DuPont's Freon Products Division.

After his discovery of Teflon®, Plunkett managed research, development, and production efforts that resulted in the creation of numerous new fluorochemical products and processes that have become widely used in the refrigeration, aerosol, electronic, plastics, and aerospace industries. Many are considered to be of critical importance to national defense.

Photo credit: Courtesy of Merck & Co., Inc.

Max Tishler

Alloxazines and Isoalloxazines and Processes for Their Production; 2-Sulphanilamido-quinoxaline

Patent Nos. 2,261,608; 2,404,199

Born October 30, 1906
Died March 18, 1989

Inducted in 1982

Organic chemist Max Tishler developed methods for synthesizing the essential vitamin B2 as well as a poultry disease antibiotic that opened the door to broad expansion of the poultry industry. Born in Boston, Tishler graduated from Tufts College in 1928 and subsequently earned M.A. and Ph.D. degrees in organic chemistry from Harvard University.

In 1937 he joined Merck & Company, Inc., where his first assignment was to find a new process for the synthesis of riboflavin that would permit economical, large-scale production of the essential vitamin B2. His success, which contributed significantly to human health and nutrition, also led to processes for the practical synthesis of other vitamins. Later Tishler and his associates synthesized and developed a production process for sulfaquinoxaline, the first effective antibiotic for the prevention and cure of the poultry disease coccidiosis. Its use as a feed additive permitted broad expansion of poultry production.

In all, Tishler received more than 100 patents relating to medicinal chemicals, vitamins, and hormones during his 33 years in industrial research. He retired from Merck in 1969 to become professor of chemistry and, subsequently, professor of the sciences, emeritus at Wesleyan University.

Photo credit: Courtesy of the Hewlett-Packard Company

William R. Hewlett

Variable Frequency Oscillation Generator

Patent No. 2,268,872

Born May 20, 1913
Died January 12, 2001

Inducted in 1992

Cofounder of the electronics giant Hewlett-Packard, William R. Hewlett invented the audio oscillator, the first practical method of generating audio signals needed in communications, geophysics, medicine, and defense work.

Hewlett was born in Ann Arbor, Michigan, and attended Stanford, receiving a B.A. in 1934 and an electrical engineering degree in 1939; his master's degree was awarded by the Massachusetts Institute of Technology in 1936. Hewlett met partner Dave Packard while an undergraduate at Stanford. While in graduate school Hewlett developed the design for the product that later launched the Hewlett-Packard company—the model HP200A audio oscillator.

Until Hewlett's invention, scientists and researchers had no simple and accurate source for low-frequency signals. One of Hewlett-Packard's first customers was Walt Disney Studios, which used the Model 200B oscillators to produce the soundtrack for the film *Fantasia*. Hewlett served as an Army officer during World War II and was named vice-president of the newly incorporated Hewlett-Packard upon his return to civilian life.

He served as president from 1964 to 1977 and as chief executive officer from 1969 to 1978. In 1989 an old garage in Palo Alto, the first home of Hewlett-Packard, became a California historical landmark. The state dedicated it as the birthplace of Silicon Valley.

Photo credit: Corning, Inc.

J. Franklin Hyde

Method of Making a Transparent Article of Silica

Patent No. 2,272,342

Born March 11, 1903
Died October 11, 1999

Inducted in 2000

J. Franklin Hyde was with Corning Glass when he discovered a way to create a pure glass called fused silica. He was also a forerunner in developing silicones, which are found in a wide range of everyday products such as lubricants, caulks, electrical insulators, and gaskets.

Prior to the 1930s, melting minerals was the only way to make glass. Hyde decided to synthesize glass from liquid silicon tetrachloride, the first time in over 3,000 years that a new way of making glass was found. Fused silica is used for spacecraft windows, telescopes, and precision lenses. The glass also serves as the basis for the optical fiber and semiconductor chip building industries. Hyde was also able to take silicon-containing compounds and turn them into silicones. Silicone rubbers are extremely resistant to aging, sunlight, moisture, temperature extremes, and many chemicals.

Hyde's work was the basis of the Dow Corning Corporation, founded in 1943. Hyde was born in Solvay, New York and attended public schools in the area until he enrolled at Syracuse University. After receiving his A.B. in 1923 and his M.A. in 1925, he received his Ph.D. in 1928 from the University of Illinois. He joined Corning in 1930, moving on to Dow Corning in 1951. During his lifetime, he received over 100 patents.

Photo credit: William Hanford Collection

William Edward Hanford

Process for Making Polymeric Products and for Modifying Polymeric Products

Patent No. 2,284,896

Born December 9, 1908
Died January 27, 1996

Inducted in 1991

William Edward Hanford and Donald Holmes discovered the process for making polyurethane, and so discovered the basic broad chemistry of polyurethanes. In 1942, they were awarded the patent for their process. Polyurethanes are now used in a diverse array of products, including artificial hearts, safety padding in modern automobiles, energy saving insulation in homes, refrigerators and offices, furniture, cushioning, and carpets.

Born in Bristol, Pennsylvania, "Butch" Hanford received his B.S. from the Philadelphia College of Pharmacy in 1930, and then went on to receive his masters and his doctorate from the University of Illinois. It was while working at DuPont in Wilmington, Delaware, that Hanford and Holmes invented their process for making polyurethane.

While at DuPont, William Hanford also found a way to apply Teflon® in a practical and efficient manner. Hanford left DuPont in 1942 to join GAF Corporation; while there, he co-developed the first household liquid detergent. In 1946 he joined M.W. Kellogg, where he became director of research and served on the board of directors. In 1957 he became research and development vice president at Olin Industries. He and his son organized Water-Sure Inc. in 1968, specializing in equipment for sanitizing water supplies in Third World countries. He had over 120 patents from the United States patent office.

Photo credit: Curtis Holmes Collection

Donald Fletcher Holmes

Process for Making Polymeric Products and for Modifying Polymeric Products

Patent No. 2,284,896

Born September 29, 1910
Died October 13, 1980

Inducted in 1991

Donald Fletcher Holmes and William Hanford invented the process for making the multipurpose material polyurethane. Some of the first polyurethanes were produced by the reaction of di-isocyanates with polyesters and polyesteramides. The process Holmes and Hanford invented reacts polyols and related hydroxy compounds with di-isocyanates. This method is the basis today for the manufacture of all polyurethanes.

Today, polyurethanes have a wide-reaching popularity. Flexible polyurethane foam is used as an upholstery material, and the rigid foam is commonly used as a heat-insulating material in homes, offices, and refrigerators. Polyurethane is also used in life-saving artificial hearts, safety padding in modern automobiles, and in carpeting. Born in Woodbury, New Jersey, Holmes received his B.S. in Organic Chemistry from Amherst College in 1931. In his Amherst senior class yearbook, it noted that his ambition was to become a great chemist.

Like Hanford, Holmes also received a masters degree and then a doctorate from the University of Illinois. He teamed up with Hanford at the E.I. duPont de Nemours & Company, receiving the polyurethane patent in 1942. Holmes remained with DuPont, working in the textile divisions until just before his death in 1980.

Photo credit: Courtesy of Battelle Memorial Institute

Chester F. Carlson

Electrophotography

Patent No. 2,297,691

Born February 8, 1906
Died September 19, 1968

Inducted in 1981

Physicist Chester F. Carlson, the father of xerographic printing, was born in Seattle, Washington. As a high school student, Carlson published a chemical magazine to support his invalid parents.

His interest in printing continued through his physics degree program at the California Institute of Technology and into his early career at the electronics firm P.R. Mallory Company, where he began working for the patent department in 1930. Plagued by needs for copies of patent drawings and specifications, Carlson investigated ways of automatic text and illustration reproduction, working out of his apartment. While others sought chemical or photographic solutions to "instant copying" problems, Carlson turned to electrostatics and in 1938 succeeded in obtaining his first "dry-copy" and the first of many patents two years later.

It took presentations to more than 20 companies before Carlson was able to interest the Battelle Development Corporation in his invention in 1944. In 1947 the Haloid Company–renamed Xerox Corporation–negotiated commercial rights to his xerographic development. Eleven years later, and ten years before Carlson's death in 1968, Xerox introduced its first office copier.

Photo credit: Courtesy of Thermo King Corporation

Frederick McKinley Jones

Air Conditioner for Vehicles

Patent No. 2,303,857

Born May 17, 1893
Died February 21, 1961

Inducted in 2007

Frederick Jones invented the first successful system for mobile refrigeration. His invention eliminated the far less effective use of ice and salt to preserve foods for transport, greatly extending the distance over which food could be successfully delivered.

In the summer of 1938, local merchant Joseph Numero made an offhanded promise to a trucking company to build a refrigerated truck that would not fail when subjected to the normal bumps and vibrations that occur during shipping. Jones, working for Numero, designed a durable, small unit with a compressor mounted under the trailer that was powered by a four-cylinder engine. Used in trucks, railroad cars, ships, and planes, Jones' technology revolutionized the distribution of food and other perishables. It made fresh produce available anywhere in the country year-round, changing Americans' eating habits.

Jones and Numero went on to found Thermo King Corporation to produce the mobile refrigeration device. Thermo King became an international corporation and had over $1 billion in annual sales when it was acquired by the Ingersoll-Rand Company in 1997.

Jones was born in Coventry, Kentucky. Despite having minimal formal schooling, he became the first African-American to be awarded the National Medal of Technology.

Photo credit: United Technologies Corp., Via National Air & Space Museum, Smithsonian Institution

Igor I. Sikorsky

Direct-Lift Aircraft; Helicopter and Controls Therefor

Patent Nos. 2,318,259; 2,318,260

Born May 25, 1889
Died October 26, 1972

Inducted in 1987

Igor I. Sikorsky designed the world's first successful multimotor airplane and the world's first true production helicopter. Born in Kiev, Russia, Sikorsky built model aircraft and helicopters as a schoolboy. He was educated in Russia and Paris, and achieved international recognition in 1913 when he designed and flew the first multimotor airplane. After the Russian Revolution he immigrated to the United States and reestablished himself as an aircraft designer.

From 1925 to 1940 he created a series of increasingly successful aircraft which won numerous world records for speed, range, and payload. The famed Sikorsky flying "Clippers" helped transoceanic commercial passenger services. Sikorsky continued to study the helicopter; he filed for a crucial patent in 1931. In late 1938, United Aircraft (now United Technologies) approved his experimental helicopter, and in 1939, the VS-300 made its first flight.

In January 1941 the U.S. Army Air Corps issued a contract for an observation helicopter designated the XR-4. Within months of the delivery of the first units, the XR-4 established the helicopter's humanitarian tradition of life-saving missions in military and civil emergencies. Sikorsky's breakthrough single-rotor design remains the dominant configuration today.

Photo credit: Courtesy of Illinois Institute of Technology

Marvin Camras

Method and Means of Magnetic Recording

Patent No. 2,351,004

Born January 1, 1916
Died June 23, 1995

Inducted in 1985

Marvin Camras' inventions are used in modern magnetic tape and wire recorders, including high frequency bias, improved recording heads, wire and tape material, magnetic sound for motion pictures, multitrack tape machines, stereophonic sound reproduction, and video tape recording. Born in Chicago, Illinois, Camras received a B.S. in 1940, an M.S. in 1942, and an Honorary Doctorate in 1978 from the Illinois Institute of Technology. He spent most of his working life at the IIT Research Institute, where he served as senior scientific adviser.

In the 1930s Camras developed a successful wire recorder. Before and during World War II his early wire recorders were used by the military to train pilots. Battle sounds were recorded and equipment was developed to amplify it by thousands of watts. The recordings were placed where the invasion of D-Day was not to take place, giving false information to the Germans. The public first heard of Camras' work after the war had ended.

Camras received more than 500 patents, largely in the field of electronic communications.

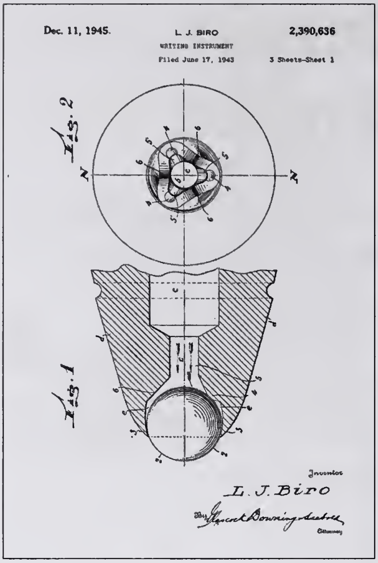

Image of patent no. 2,390,636 courtesy of the United States Patent and Trademark Office.

Laszlo Josef Biro

Writing Instrument

Patent No. 2,390,636

Born September 29, 1899
Died October 24, 1985

Inducted in 2007

Laszlo Biro invented the modern ballpoint pen.

A native of Budapest, Hungary, Biro was working as a journalist when he noticed a fundamental difference between two types of ink. Ink for fountain pens was easy to smudge because it needed time to dry, yet ink used in newspaper printing presses dried much faster, leaving dry paper with a smudge-free product. He tried using the newspaper printing ink in a fountain pen but found it was too thick to flow through the tip.

Needing a way to combine the qualities of both inks, Biro worked to perfect the design. It consisted of a ball that freely rotated in a socket. Moving the pen across the page made the ball rotate, where it picked up ink from a reservoir and applied it to the page. The Biro pen was the first successful ballpoint writing instrument.

His pen came to the attention of a British clerk who thought the pen would be useful to airplane navigators because it was not dependent on pressure for ink distribution, working well at high altitudes. The British government bought Biro's patent and had the pens made for the Royal Air Force. From this, Biro's pen quickly gained commercial success.

Photo credit: Courtesy of The Smithsonian Institution

Robert Hutchings Goddard

Control Mechanism for Rocket Apparatus

Patent No. 2,397,657

Born October 5, 1882
Died August 10, 1945

Inducted in 1979

Robert Hutchings Goddard pioneered modern rocketry and space flight and founded a whole field of science and engineering. Born in Worcester, Massachusetts, Goddard graduated from Worcester Polytechnic Institute in 1908, then became a physics instructor at Worcester Tech. He also completed graduate work at Clark University, where he received his M.A. in 1910 and a Ph.D. in 1911. He was then a research fellow at Princeton and in 1914 joined the faculty at Clark University, becoming a full professor in 1919. As early as 1908, Goddard conducted static tests with small solid-fuel rockets at Worcester Tech, and in 1912 he developed the detailed mathematical theory of rocket propulsion.

In 1915 he proved that rocket engines could produce thrust in a vacuum and therefore make space flight possible. In 1916 the Smithsonian Institution provided funds for Goddard to continue his work on solid-propellant rockets and to begin development of liquid-fuel rockets as well.

During World War I, Goddard succeeded in developing several types of solid-fuel rockets to be fired from hand-held or tripod-mounted launching tubes, which were the basis of the bazooka and other powerful weapons of World War II.

During World War II, he was assigned by the U.S. Navy to develop rocket-assisted takeoff of carrier planes and variable-thrust liquid-fuel rocket motors. At the time of his death Goddard held 214 patents in rocketry.

Photo Credit: Courtesy San Diego Aerospace Museum

Frank Whittle

Aircraft Propulsion System and Power Unit

Patent No. 2,404,334

Born June 1, 1907
Died August 8, 1996

Inducted in 2003

By 1929, Frank Whittle had conceptualized the turbojet engine. The 1930s, however, proved challenging as he sought financial support and interest from the British Air Ministry. It was not until May 15, 1941, that the Whittle W1 jet engine, housed in the Gloster E.28/39, made its maiden flight. Whittle's jet engine is marked as one of the greatest contributions in aviation history.

Born in Coventry, England, Whittle attended the Royal Air Force College and subsequently became an instructor and test pilot while pursuing alternate means of producing higher speeds at greater altitudes. In 1930, he applied for a patent for his turbojet engine, and it was granted in 1932. In 1936, Whittle received limited private financial support and Power Jets Limited was formed. Five years later, his engine made its historic flight.

In 1976, he moved to the U.S. where he became Naval Air Systems Command Research Professor and from 1979, Adjunct Research Professor, U.S. Naval Academy. Whittle's vision and determination changed the aviation industry and was recognized with awards, including the Charles Stark Draper Prize and the Guggenheim Medal. Whittle was knighted by King George VI in 1948.

Photo Credit: Courtesy of Northrop Grumman Corporation

John K. Northrop

All-Wing Airplane

Patent No. 2,406,506

Born November 10, 1895
Died February 18, 1981

Inducted in 2003

Jack Northrop was a true artist of aircraft design. His creativity led him to design the Lockheed Vega, a design with a monocoque, or single-shell, fuselage with internal-braced wings. This novel design produced a number of speed, altitude, and endurance records and began Northrop's legacy of building superior, cutting-edge planes.

Northrop was born in Newark, New Jersey. In the 1920s and 1930s, Northrop designed the Vega as well as the Alpha, Beta, Delta, and Gamma planes. These designs produced great advances in flight performance and airframe life. He also began researching and designing his Flying Wing and tailless aircraft. By 1939 Northrop Aircraft was established, and he worked intimately with the military. His P-61 Black Widow night fighter endowed the U.S. with superior aircraft. His XB-35 aircraft, a working model of his Flying Wing, was shelved in the 1940s, but 40 years later, was renewed as the B-2 Stealth Bomber.

Northrop's other creations are significant: the F-89 Scorpion all-weather fighter interceptor, the B-49 long-range bomber, the Snark intercontinental missile, automatic celestial navigation systems, and prosthetic limbs. He is lauded as a pioneering designer in aviation.

Photo credit: Courtesy of Raytheon Co. Archives

Percy L. Spencer

High Efficiency Magnetron

Patent No. 2,408,235

Born July 19, 1894
Died September 8, 1970

Inducted in 1999

Percy Spencer, while working for the Raytheon Company, discovered a more efficient way to manufacture magnetrons. This discovery led to significant advances in radar and his most popular invention, the microwave oven.

In 1941, magnetrons were being produced at a rate of 17 per day. Spencer set out to create a simpler magnetron that could be mass produced. The result was a magnetron that replaced precision copper bars with lamina and replaced soldered internal wires with a simple solid ring. These improvements and others allowed for the faster production of 2,600 magnetrons per day. In 1945, Spencer created a device to cook food using microwave radiation.

Raytheon saw the possibilities of this, and after acquiring Amana Refrigeration in 1965, was able to sell microwave ovens on a large scale. The first microwave oven was called the Radarange, and today, there are over 200 million in use throughout the world.

Spencer, born in Howland, Maine, was orphaned at a young age. Although he never graduated from grammar school, he became Senior Vice President and a member of the Board of Directors at Raytheon, receiving 150 patents during his career. Because of his accomplishments, Spencer was awarded the Distinguished Service Medal by the U.S. Navy and has a building named after him at Raytheon.

Photo credit: *National Center for Agricultural Utilization and Research, Agricultural Research Service, United States Department of Agriculture*

Andrew J. Moyer

Method for Production of Penicillin

Patent Nos. 2,442,141; 2,443,989

Born November 30, 1899
Died February 17, 1959

Inducted in 1987

Andrew J. Moyer's discoveries provided the foundation for the industrial production of penicillin. Born in Star City, Indiana, Moyer received his A.B. degree from Wabash College in 1922 and his M.S. from North Dakota Agricultural College in 1925.

In 1929 he was awarded his Ph.D. in plant pathology from the University of Maryland. Moyer was employed as a mycologist with the U.S. Department of Agriculture, then worked as a microbiologist at the USDA Northern Regional Research Laboratory in Peoria, Illinois, until his retirement in 1957.

The potential of using penicillin to treat wounded soldiers was immediately recognized in World War II. However, a practical method for large-scale production was not available. The task was assigned to Moyer, who found that by culturing the Penicillium mold in a culture broth of corn steep liquor and lactose, penicillin yields could be increased. This was the first known use of corn steep liquor for growing microorganisms.

Moyer also discovered that with this medium, the fermentation could be conducted with continuous shaking, even further enhancing the yields and production rate. These discoveries led to industrial penicillin production, which saved thousands of lives during the war. Moyer's work also provided a model for the development of all other antibiotic fermentations.

Selman Waksman

Photo credit: Special Collections and University Archives, Rutgers University Libraries

Antibacterial Substance and Method of Producing It

Patent No. 2,443,485

Born July 22, 1888
Died August 16, 1973

Inducted in 2005

Selman Waksman revolutionized medicine and saved the lives of countless tuberculosis patients with streptomycin, a powerful antibiotic.

As a pioneer in microbiology, Waksman specialized in the study of microbes in soil. He recognized that microorganisms produced many organic substances with unknown properties and created a screening system to isolate and identify those substances with antibiotic properties. By examining thousands of soil samples, his lab identified a number of viable antibiotic drugs. The most important find, streptomycin, provided the first effective treatment for tuberculosis, a disease that had ravaged mankind. Previously, tuberculosis victims were kept in sanitaria where their main treatment was fresh air and a healthy diet.

Waksman's success inspired others to research antibiotics. Royalties from patents generated enormous profits, enabling Waksman to establish and fund the Waksman Institute of Microbiology at Rutgers University and the Foundation for Microbiology, which now bears his name.

Born near Kiev, in the Ukraine, Waksman traveled to the U.S. to study at Rutgers, later receiving his Ph.D. from the University of California. The recipient of many honors, Waksman won the Nobel Prize for Physiology or Medicine in 1952 and is credited with coining the term "antibiotic."

Photo credit: Estate of Louis W. Parker

Louis W. Parker

Television Receiver

Patent No. 2,448,908

Born January 1, 1906
Died June 21, 1993

Inducted in 1988

Louis W. Parker invented the intercarrier sound system for television sets, the modern basis for coordinating sound and picture. Born in Budapest, Hungary, Parker immigrated to the United States as a young man, becoming a citizen in 1932. After learning English, he studied at the City College of New York.

Parker first gained publicity in 1929 with a hotel radio system that used low-frequency signals to broadcast over the electric wires within the building. Later he worked on radio direction finders for airplanes and cathode ray oscilloscopes, which led to work on television and closed circuit television systems. During World War II, Parker designed and manufactured portable radio transmitters for military use.

After the war he created the intercarrier sound system still used in all television receivers. Without it, television receivers would not work as well and would be more costly. Among Parker's other inventions was the first color television system using vertical color lines. This made it possible to change from the original three-color dot system to the simpler vertical color-line system. Later, he invented electrical instruments which were greatly superior in performance and which were the basis for the Parker Instrument Corporation. The company was chosen by NASA to furnish selected instruments for use in the manned Apollo flights to the moon.

Photo Credit: Post Street Archives

Otis Ray McIntire

Manufacture of Cellular Thermoplastic Products

Patent No. 2,450,436

Born August 24, 1918
Died February 2, 1996

Inducted in 2008

Ray McIntire invented polystyrene foam, more commonly known by its brand name, STYROFOAM®. Patented in 1944, today STYROFOAM® is a leading brand of insulation used in millions of homes and buildings around the world to increase energy efficiency and protect against wind, rain, and moisture. The material is also a favorite among crafters.

McIntire was born in Gardner, Kansas. After graduating from the University of Kansas with a B.S. degree in engineering in 1940, he went to work for Dow Chemical Company. During World War II, when rubber was in short supply, McIntire's work focused on developing a rubber-like substance that could be used as a flexible insulator. In an experiment in which he combined styrene with isobutylene, he was surprised to find that the isobutylene formed tiny bubbles within the styrene. McIntire had accidentally invented foam polystyrene that was 30 times lighter and more flexible than solid polystyrene. The new material also exhibited outstanding thermal and moisture-resistant properties and was inexpensive to make.

McIntire remained at Dow Chemical for his entire career. He was promoted to research director, and later worked in the company's consumer and venture capital divisions. He retired in 1981 as Dow's director of technology and acquisition.

Photo credit: Courtesy of Donald Campbell

Donald L. Campbell

Method and Apparatus for Contacting Solids and Gases

Patent No. 2,451,804

Born August 5, 1904
Died September 14, 2002

Inducted in 1999

Donald Campbell was one of four Exxon Research & Engineering Co. (ER&E) inventors who revolutionized the petroleum industry through fluid catalytic cracking, a process that greatly increases the yield of high-octane gasoline from crude oil.

Campbell and his colleagues began thinking of a design that would allow for a moving catalyst, to ensure a steady and continuous cracking operation. The four ultimately invented a fluidized solids reactor bed and a pipe transfer system between the reactor and the regenerator unit in which the catalyst is processed for re-use. In this way, the solids and gases are continuously brought in contact with each other to bring on the chemical change. This work culminated in a 100 barrel-per-day demonstration pilot plant. The first commercial production plant processed 13,000 barrels of heavy oil daily, making 275,000 gallons of gasoline.

Campbell, born in Clinton, Iowa, was always fascinated by inventing and solving problems. He first attended Iowa State University, then MIT and the Harvard Business School. During his 41 years at Exxon, 25 were spent at ER&E. At his retirement in 1969, he held 30 patents and was assistant to the vice president of New Areas of Research.

Photo credit: Exxon Research & Engineering Co.

Homer Z. Martin

Method and Apparatus for Contacting Solids and Gases

Patent No. 2,451,804

Born November 20, 1910
Died September 1, 1993

Inducted in 1999

Homer Martin was with Exxon Research & Engineering Co. (ER&E) when the company was looking for a way to increase the yield of high-octane gasoline from crude oil. Martin and three of his colleagues devised fluid catalytic cracking, considered one of the most important chemical engineering achievements of the 20th century.

Considered essential to the refinery, fluid cat cracking produces gasoline as well as heating oil, fuel oil,propane, butane, and chemical feedstocks that are instrumental in producing other products such as plastics, synthetic rubbers and fabrics, and cosmetics. During today's fluid cat cracking, a boxcar load of catalyst is mixed with a stream of oil vapor every minute. This mixture, behaving like a fluid, moves continuously through the system as cracking reactions take place. Fluid cat cracking currently takes place in over 370 units around the world, producing almost one half billion gallons of gasoline daily. Its technology continues to evolve as cleaner high-performance fuels are explored.

Martin was born in Chicago, Illinois. He received his B.S. in chemical engineering from Armour Institute and his M.S. and Ph.D. from the University of Michigan. After joining ER&E in 1937, he became one of its most prolific inventors, with 82 patents upon his retirement in 1973.

Photo credit: Exxon Research & Engineering Co.

Eger V. Murphree

Method and Apparatus for Contacting Solids and Gases

Patent No. 2,451,804

Born November 3, 1898
Died October 29, 1962

Inducted in 1999

Eger Murphree, former president of Exxon Research & Engineering Co. (ER&E), was one of four Exxon inventors who created the fluid catalytic cracking process.

When ER&E's first commercial cat cracking facility went on-line in 1942, the U.S. had just entered World War II and was facing a shortage of high-octane aviation gasoline. This new process allowed the U.S. petroleum industry to increase output of aviation fuel dramatically over the next three years. Fluid cat cracking also aided the rapid buildup of butadiene production. Butadiene was needed for ER&E's process for making synthetic butyl rubber, a new technology vital to the Allied war effort. Murphree was born in Bayonne, New Jersey, moving as a youngster to Kentucky. At Kentucky University, he graduated with undergraduate degrees in chemistry and mathematics in 1920, and then with a master's degree in chemistry in 1921. After teaching high school and working for several years, in 1930 he joined what was then Standard Oil of New Jersey. From 1947 to 1962, he served as president.

Murphree, who was a member of the committee that organized the Manhattan Project, was widely recognized as a leader in the fields of synthetic toluene, butadiene and hydrocarbon synthesis, fluid cat cracking, fluid hydroforming, and fluid coking.

Photo credit: Exxon Research & Engineering Co.

Charles W. Tyson

Method and Apparatus for Contacting Solids and Gases

Patent No. 2,451,804

Born 1900
Died 1977

Inducted in 1999

Charles "Wes" Tyson and his three co-inventors at Exxon Research & Engineering Co. (ER&E), called the Four Horsemen, were part of the team responsible for developing fluid catalytic cracking, the process that produces over half the world's gasoline. They developed the process in 1942, and the first commercial fluid cat cracking facility went on-line on May 25, 1942.

In the 1930s, ER&E was looking for a way to increase the yield of high-octane gasoline from crude oil. Researchers discovered that a finely powdered catalyst behaved like a fluid when mixed with oil in the form of vapor. During the cracking process, a catalyst will split hydrocarbon molecule chains into smaller pieces. These smaller, or cracked, molecules then go through a distillation process to retrieve the usable product. During the cracking process, the catalyst becomes covered with carbon; the carbon is then burned off and the catalyst can be re-used.

Tyson was born in Chicago, Illinois. In 1930, after receiving his bachelor's and master's degrees in chemical engineering from MIT, he joined ER&E. He served as director of the Petroleum Development Division before his appointment in 1961 as special assistant to the vice president of ER&E. At his retirement in 1962, Tyson held over 50 patents, mainly in the petroleum processing area.

Photo credit: David Sarnoff Research Center Archives

James Hillier

Electron Lens Correction Device

Patent No. 2,455,676

Born August 22, 1915
Died January 15, 2007

Inducted in 1980

Physicist James Hillier was recognized for his contributions to the development of the electron microscope. Born in Brantford in Ontario, Canada, he received his B.S. in 1937 and Ph.D. in physics in 1941 from the University of Toronto.

Hillier's work on the electron microscope lens correction device began in college. He and a fellow graduate student built a model in 1937 that magnified 7,000 times. A generation later more than 2,000 electron microscopes were in use in the laboratories of the world, some capable of magnifying two million times.

Hillier was a research engineer at RCA Laboratories from 1940 to 1953, at which time he joined Melpar Inc. as research director. In 1954 he returned to RCA, where he became the general manager of RCA Laboratories in Princeton, New Jersey in 1957. When he retired in 1978, Hillier was executive vice president and senior scientist of RCA Labs.

Established in 1993, The James Hillier Foundation awards annual scholarships to Brant County (Ontario) students seeking education in science.

Hillier held 40 patents.

Photo credit: Courtesy of Merck & Co., Inc.

Lewis Hastings Sarett

Process of Treating Pregnene Compounds

Patent No. 2,462,133

Born December 22, 1917
Died November 28, 1999

Inducted in 1980

Chemist Lewis Hastings Sarett prepared a synthetic version of the hormone cortisone, which was soon demonstrated as an effective treatment against rheumatoid arthritis. Born in Champaign, Illinois, Sarett received his B.S. from Northwestern University in 1939 and his Ph.D. from Princeton in 1942. That same year he joined Merck Research Laboratories in Rahway, New Jersey, as a research chemist.

Sarett prepared the first synthetic cortisone in 1944, when Merck & Co. was a participant in a government effort to improve military medicine. Four years later the Mayo Clinic demonstrated the efficacy of the product against rheumatoid arthritis. In 1949, Sarett and several collaborators initiated an alternative synthesis commencing with raw materials derivable from coal, air, lime, and water. This led to the first route independent of naturally occurring starting materials.

Sarett's career at Merck spanned 38 years. He retired in 1982 as senior vice president for science and technology. He was named as primary inventor or a collaborator on approximately 100 technical papers and patents.

Photo credit: The Harold E. Edgerton 1992 Trust, courtesy of Palm Press, Inc

Harold E. Edgerton

Stroboscope

Patent No. 2,478,903

Born April 6, 1903
Died January 4, 1990

Inducted in 1986

Pioneering research in stroboscopic photography by Harold E. Edgerton was the foundation for the development of the modern electronic speed flash. Born in Fremont, Nebraska, Edgerton graduated from the University of Nebraska and the Massachusetts Institute of Technology.

He joined MIT as a research assistant in 1927, became a professor in 1948, and was Institute professor emeritus from 1966 until his death. Edgerton earned international recognition for his achievements in the related fields of stroboscopy and ultra-high speed photography. The electronic speed flash his research spurred is important to science and industry as well as routine photography. He originally perfected the use of stroboscopic lights in both ultra-high-speed motion and still (stop-motion) photography capable of revealing operations which move at speeds beyond the perceptive capacity of the human eye, such as bullets in flight and light bulbs shattering.

Edgerton also made significant contributions to underwater exploration and worked aboard the ship *Calypso* with Jacques Cousteau and his crew in explorations of sea floors in the Mediterranean and other locations. Edgerton was one of the founding partners of E G & G, Inc. (formerly Edgerton, Germeshausen and Grier), a company specializing in electronic technology. He also helped organize and build the New England Aquarium in Boston.

Photo credit: Leonard Greene Collection

Leonard Michael Greene

Stall Warning Device for Airplanes

Patent No. 2,478,967

Born June 8, 1918
Died November 30, 2006

Inducted in 1991

Leonard Michael Greene patented dozens of inventions in aviation technology, including the device that warns pilots when a deadly aerodynamic stall is imminent. Born in New York City, Greene received his B.S. and M.S. degrees from City University of New York. In 1977 he was awarded an honorary doctorate by Pace University.

During World War II, Greene joined the Grumman Aircraft Corporation. Witness to an aircraft accident caused by stall, he realized the pilot could not tell when the angle of airflow over the wing had become excessive. The stall-warning device Greene invented was the first of more than 100 patents, 60 of which cover aviation technology.

When Greene invented the stall-warning device, more than half of all aviation deaths were caused by the stall/spin. A *Saturday Evening Post* article in 1947 said of Greene's innovation, "It may be the greatest life saver since invention of the parachute." To build his invention, Greene established the Safe Flight Instrument Corporation in White Plains, New York, in 1946.

Other Greene inventions included a wind-shear warning system that warns a pilot if an aircraft enters a dangerous microburst and provides escape guidance. The firm supplies unique air safety and performance technology to virtually every major air carrier, the U.S. Armed Forces, and to aircraft manufacturers worldwide.

Photo credit: AIP Emilio Segrè Visual Archives, Physics Today Collection

Luis Walter Alvarez

Radio Distance and Direction Indicator

Patent No. 2,480,208

Born June 13, 1911
Died September 1, 1988

Inducted in 1978

Luis Walter Alvarez invented a radio distance and direction indicator. During World War II, he designed a landing system for aircraft and a radar system for locating planes. Later, he helped develop the hydrogen bubble chamber, used to detect subatomic particles. This research led to the discovery of over 70 elementary particles and resulted in a major revision of nuclear theories.

Born in San Francisco, Alvarez graduated from the University of Chicago with a B.S. in 1932 and a Ph.D. in 1936. He was an assistant physics instructor from 1936 to 1938; an associate professor from 1938 to 1945; associate director of the Lawrence Berkeley Laboratory from 1954 to 1959; and a professor of physics at the University of California, Berkeley, in 1945. He was a staff member in the radiation laboratory at the Massachusetts Institute of Technology from 1940 to 1943; at the metal laboratory at the University of Chicago from 1943 to 1944, and at the Los Alamos Laboratory in New Mexico from 1944 to 1945, at which time he received the patent for the radio distance and direction indicator.

Alvarez was a member of the President's Science Advisory Committee from 1971 to 1972. He was awarded the Nobel Prize in Physics in 1968.

Photo credit: International Scuba Diving Hall of Fame

Jacques-Yves Cousteau

Diving Equipment

Patent No. 2,485,039

Born June 11, 1910
Died June 25, 1997

Inducted in 2010

Jacques Cousteau and Emile Gagnan together invented the modern demand regulator used in underwater diving. Their invention allowed for the equipment known as the Aqualung, or self-contained underwater breathing apparatus (SCUBA), enabling safer and deeper dives.

Previously, divers were only able to explore the sea using diving bells or helmeted diving suits which were cumbersome and expensive. Divers were also dependent on air hoses connected to a surface source. Cousteau was searching for an underwater breathing apparatus that would allow divers to enjoy unencumbered swimming. He teamed with Gagnan, a Parisian engineer working at Air Liquide who had created a valve for regulating gas flow to gas-generator engines. Combining Gagnan's engineering expertise with Cousteau's practical experience, they created a demand valve system that could provide a diver with compressed air on demand and that adjusted to the surrounding pressure.

The Aqualung was introduced in 1946 and was available on the U.S. market in 1952. It provided safe and low-cost opportunities for scientists, engineers, and underwater enthusiasts.

Cousteau, born in France, was well-known as an innovator and entrepreneur in the world of underwater exploration. He came into wide recognition with the publication of *The Silent World* in 1953 and the movie release in 1956, and developed into a highly recognizable figure who also spent years working on marine conservation.


Photo credit: International Scuba Diving Hall of Fame

Emile Gagnan

Diving Equipment

Patent No. 2,485,039

Born November 1900
Died 1984

Inducted in 2010

Emile Gagnan and Jacques Cousteau together invented the modern demand regulator used in underwater diving. Their invention allowed for the equipment known as the Aqualung, or self-contained underwater breathing apparatus (SCUBA), enabling safer and deeper dives.

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A native of France, Gagnan was working at Air Liquide when he first began collaborating with Cousteau. He emigrated to Canada in the late 1940s where he worked for Canada Liquid Air, Ltd., designing and developing many of the technologies found in modern SCUBA equipment, before returning to France in the 1970s.

Photo credit: Courtesy of University of Illinois Archives, Record Series 39/2/20, FAC-4

John Bardeen

Semiconductor Amplifier; Three-Electrode Circuit Element Utilizing Semiconductive Materials

Patent Nos. 2,502,488; 2,524,035

Born May 23, 1908
Died January 30, 1991

Inducted in 1974

The only person to win two Nobel Prizes in physics was John Bardeen, first in 1956 for the transistor, and then in 1972 for his theory of superconductivity. The transistor, developed with Walter Brattain and William Shockley, performed electronic functions similar to the vacuum tube in radio and television, but was smaller and used less energy. The transistor became the basis for all modern electronics and the foundation for the microchip and computer technology.

In the late 1940s, Bardeen explained theoretically how a semiconductor device worked, and that laid the groundwork for the actual transistor. In 1950 the first practical models were made. Born in Madison, Wisconsin, Bardeen obtained his Ph.D. in 1936 in mathematics and physics from Princeton University. A staff member of the University of Minnesota, Minneapolis, from 1938 to 1941, he served as principal physicist at the U.S. Naval Ordnance Laboratory in Washington, D.C., during World War II, after which he joined Bell Telephone Laboratories, Inc. Bardeen is also responsible for a theory of superconductivity, the property of some metals to lose all electrical resistance at very low temperatures. His work with superconductivity has been used in the development of fast computers and artificial intelligence.

In 1977, Bardeen received the Presidential Medal of Freedom, the highest honor awarded a civilian.

Photo cred ᵗ: Property of AT&T Archives, Reprinted with permission of AT&T

Walter H. Brattain

Semiconductor Amplifier; Three-Electrode Circuit Element Utilizing Semiconductive Materials

Patent Nos. 2,502,488; 2,524,035

Born February 10, 1902
Died October 13, 1987

Inducted in 1974

Physicist Walter Brattain shared the 1956 Nobel Prize with William Shockley and John Bardeen for jointly inventing the transistor, a device that replaced the bulky and fragile vacuum tube in electronic equipment. By the 1930s, vacuum tubes were standardly used, but their limitations were preventing technological advances. They needed large amounts of power and cooling systems to protect against overheating, and in fact, vacuum tubes were a main obstacle in developing bigger computers.

As Bell Labs worked on finding a replacement for the vacuum tube, the best candidate seemed to be the semiconductor, which eventually led to the transistor. Today, the transistor, which amplifies current in an extremely efficient manner, can be found everywhere. Products ranging from "boom boxes" to desktop computers, from calculators to pacemakers, and from televisions to generators all contain transistors.

Brattain was born in Amoy, China, and upon receiving his doctorate in 1929, he went to work at Bell Labs as a research physicist. His chief field of research involved investigations into the surface properties of solids, particularly the atomic structure of a material at the surface, which usually differs from its atomic structure in the interior. He was granted a number of patents and wrote extensively on solid state physics.

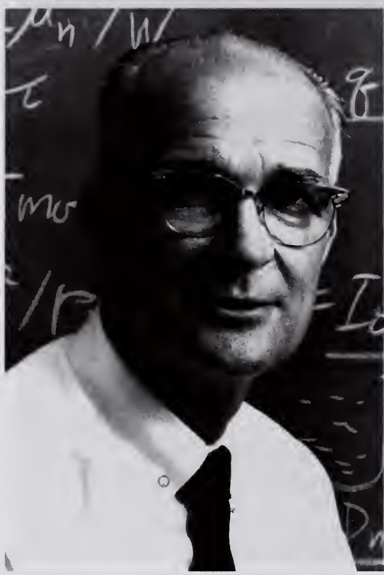
Photo credit: Stanford University News Service

William B. Shockley

Semiconductor Amplifier; Three-Electrode Circuit Element Utilizing Semiconductive Materials

Patent Nos. 2,502,488; 2,524,035

Born February 13, 1910
Died August 12, 1989

Inducted in 1974

William Shockley headed the team at Bell Telephone Laboratories that studied semiconductors and invented the transistor. The work that he and fellow physicists John Bardeen and Walter Brattain undertook earned them the 1956 Nobel Prize in physics.

In the 1930s, Bell Labs was working on a way to develop a solid-state device to replace vacuum tubes. Shockley suggested that electrical current could be increased, or amplified, using semiconductors and metals. The team consequently amplified electrical current with a "transfer resistor" or transistor by placing a germanium semiconductor between two metallic contacts. This transistor was able to greatly further technological advances.

Shockley was born in London. He joined Bell Labs in 1936, although during World War II he served as director of research for the Antisubmarine Warfare Operations Research Group of the U.S. Navy. After the war, he returned to Bell as director of transistor physics research.

He joined Beckman Instruments Inc., to establish the Shockley Semiconductor Laboratory in 1955, became a lecturer at Stanford University in 1958, and became the first Poniatoff professor of engineering science at Stanford in 1963.

Photo credit: Courtesy of Polaroid Corporation

Edwin Herbert Land

Photographic Product Comprising a Rupturable Container Carrying a Photographic Processing Liquid

Patent No. 2,543,181

Born May 7, 1909
Died March 1, 1991

Inducted in 1977

Physicist, manufacturing executive, and inventor Edwin Herbert Land developed the first modern polarizers for light, theories and practices for applications of polarized light, improvements in infrared night-vision instruments, and polarized sunglasses and lenses. He is best remembered for the instant one-step photography made famous by the company he founded, Polaroid Corporation.

Born in Connecticut, Land was educated at Norwich Academy and Harvard University. The Polaroid Corporation was founded in 1937; it prospered during World War II producing filters for goggles, gunsights, periscopes, range finders, aerial cameras, and the Norden bombsight. In 1948, the Polaroid Land Camera was introduced and became an immediate commercial success.

Many applications were found for the Land Camera and improved camera models became available for use in aerial, real estate, and commercial and press photography. Under Land, The Polaroid Corporation became a model company in terms of fair hiring practices, employee relations, and community involvement.

During World War II, he also developed optical and other systems for military use and proposed the retinex theory of color perception, in addition to creating cameras and films that gave instantaneous dry photographs in black and white and color.

Photo credit: From the Collections of the University of Pennsylvania Archives

J. Presper Eckert

Data Translating Apparatus

Patent No. 2,577,141

Born April 9, 1919
Died June 3, 1995

Inducted in 2002

J. Presper Eckert was co-inventor of ENIAC, introduced to the public at the University of Pennsylvania in 1946. ENIAC was considered a computer marvel, containing over 17,000 vacuum tubes and weighing over 30 tons.

Although ENIAC was not the first computer, it was the first electronic device designed to carry out general-purpose computation. It could add, subtract, multiply, divide, and extract square roots, as well as predict weather, calculate atomic energy, study cosmic rays and examine wind tunnel design. ENIAC, housed at the Moore School of Engineering, was 1,000 times faster than previous electromechanical calculators.

Eckert was born in Philadelphia and attended the University of Pennsylvania. He graduated in 1941 with hisB.S. and in 1943 with his M.S., both in electrical engineering. An outstanding student, he was given a teaching post at the university's electrical engineering school soon after his graduation. His role with the ENIAC project, which began in 1943, was as chief engineer. In 1946, Eckert and John Mauchly began the Electronic Control Company, later the Eckert Mauchly Computer Corporation. Eckert remained with the company when it was acquired by Remington Rand and when it merged with Burroughs Corporation, becoming Unisys. He retired from Unisys in 1989.

Photo credit: From the Collections of the University of Pennsylvania Archives

John Mauchly

Data Translating Apparatus

Patent No. 2,577,141

Born August 30, 1907
Died January 8, 1980

Inducted in 2002

John Mauchly co-invented the first practical electronic digital computer. ENIAC, the Electronic Numerical Integrator and Computer, was initially meant to compute World War II ballistic firing tables. Housed at the University of Pennsylvania, then moved to the U.S. Army's Aberdeen Proving Ground in Maryland, ENIAC could calculate in 30 seconds what would take a person 20 hours.

Mauchly and Presper Eckert led a team to construct the computer, with Mauchly developing the mathematical theory. Construction was not complete until after the war, too late to complete the original purpose of calculating firing tables for artillery. Instead, test runs in 1945 involved millions of discrete calculations or top-secret thermonuclear chain reactions for the hydrogen bomb.

Born in Cincinnati, Mauchly attended Johns Hopkins University, receiving a Ph.D. in physics in 1932. Until 1941, he taught physics at Ursinus College. He then went to the Moore School of Electrical Engineering at the University of Pennsylvania. In 1946, Mauchly and Eckert left the Moore School to begin the Eckert Mauchly Computer Corporation. Together, they marketed UNIVAC (Universal Automatic Computer), the first commercial computer. In 1959, Mauchly formed the consulting firm of Mauchly Associates.

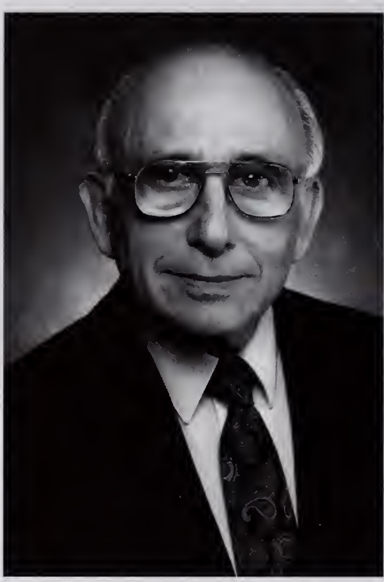

Photo credit: Courtesy of the Woodland Family

N. Joseph Woodland

Classifying Apparatus and Method

Patent No. 2,612,994

Born September 6, 1921

Inducted in 2011

Joe Woodland and Bob Silver invented the first optically scanned barcode. Their work is recognized as the original concept for the barcode technology used in industries across the spectrum.

In hopes that their idea would be further developed, Woodland took a job with IBM in 1951. In 1973, a rectangular barcode promoted by IBM, after substantial design input by Woodland, was formally adopted as the Universal Product Code (UPC).

All companies gave up their own methods of product identification and registered with the new Uniform Code Council, today called the GS1 US. Using the UPC barcode, retail stores could control inventory more efficiently, provide faster and more accurate checkouts for customers, and easily gather information for marketing reports.

Today, the barcode has many additional applications such as tracking shipped packages, boarding passes and luggage routing for air travel, tickets for entertainment events, store registries such as bridal and baby registries, patient identification in hospitals, and floor control in warehouses. Each day, the GS1 US estimates that five billion scans take place worldwide.

After growing up in Atlantic City, Woodland attended Drexel for his B.S. and Syracuse University for his M.S. He spent much of his career at IBM, retiring in 1987. In 1992, he received the National Medal of Technology.

Photo credit: Courtesy of Silver Family

Bernard Silver

Classifying Apparatus and Method

Patent No. 2,612,994

Born September 21, 1924
Died August 28, 1963

Inducted in 2011

Bob Silver and Joe Woodland invented the first optically scanned barcode. They were prompted in their work in 1948 after Silver overheard a food chain executive asking a Drexel University dean to undertake research on automatically capturing product information at checkout.

The pair worked together to create a shape of concentric circles, or what became known as the "bulls eye" symbol, which served as the code to be scanned. They built an actual bar code reader in 1951 which could electronically read the code.

By this time, Woodland was working at IBM in hopes of pursuing their idea. Eventually, a rectangular barcode that was promoted by IBM was formally adopted as the Universal Product Code (UPC), some years after Silver's death from acute leukemia. Today, the barcode has many applications such as tracking shipped packages, boarding passes and luggage routing for air travel, tickets for entertainment events, store registries, patient identification in hospitals, and floor control in warehouses. Each day, the GS1 US estimates that five billion scans take place worldwide.

Born in Pennsylvania, Silver attended Drexel where he received his B.S. in electrical engineering. Another well-known invention was a disposable thermocouple affixed to a lance, known as the Silver Lance, to measure the temperature of molten steel.

Photo credit: ©Zamboni Company Archives

Frank J. Zamboni

Ice Rink Resurfacing Machine

Patent No. 2,642,679

Born September 16, 1901
Died July 27, 1988

Inducted in 2007

Frank Zamboni invented the ice-resurfacing machine that bears his name to this day.

Working in California, Zamboni and his brothers were partners in an enterprise that made and sold block ice. As the block ice industry declined due to mobile refrigeration, the Zamboni brothers instead used their ice making knowledge to create an indoor ice rink called Iceland in 1940.

The ice rink proved so successfulthat keeping the ice smooth was a labor-intensive job, requiring a crew of five people to work for an hour and a half. The crew was required to scrape the top surface of the ice, sweep away the shavings, wash down the surface, mop it clean, and spray a final coat of water.

By 1949, Zamboni created a prototype of his ice-resurfacing machine that could complete the work in fifteen minutes. Mass production of the machines began in 1954, and they received international exposure when used at the 1960 Winter Olympics in Squaw Valley, California. Zamboni's machines quickly became indispensable at ice rinks everywhere.

Born in Eureka, Utah, Zamboni attended trade school in Chicago before joining his brothers in California. Prior to their block ice business, they were partners in a garage.

Photo credit: Courtesy of the Wallace H. Coulter Foundation

Wallace Coulter

Means for Counting Particles Suspended in a Fluid

Patent No. 2,656,508

Born February 17, 1913
Died August 7, 1998

Inducted in 2004

One of the giant corporate players in the field of medical technology grew from a fundamental invention Wallace Coulter made in his basement in 1948. The Coulter Principle provided a methodology for counting, measuring and evaluating microscopic particles suspended in fluid. His invention led to major breakthroughs in science, medicine and industry. This principle was the origin of Coulter's numerous inventions, which revolutionized healthcare and standardized quality control in industry. Medicine's most prescribed test, the Complete Blood Count, became routine, affordable, accurate and fast.

Wallace Coulter co-founded the Coulter Corporation with his brother Joseph, where they made significant advances in hematology, immunology, cytometry, cancer and infectious disease diagnostics and fine particles analysis.

Born in Little Rock, Arkansas, Coulter studied at Westminster College and the Georgia Institute of Technology. He received many awards and honors, including the IEEE Morris E. Leeds Award (1980), the IEEE Fellow Award (1983), and the Charles Stark Draper Prize (1988). He supported scientific research and humanitarian efforts through the work of the Coulter Foundation.

Photo credit: U.S. National Library of Medicine

Gregory Pincus

Biochemical Processes for the 11-Hydroxylation of Steroids

Patent No. 2,666,015

Born April 9, 1903
Died August 22, 1967

Inducted in 2006

By creating the first practical oral contraceptive, the birth control pill, in the 1950s, Gregory Pincus brought privacy and convenience to women worldwide.

New breakthroughs in birth control came in the early 1950s from Carl Djerassi's successful synthesis of orally active analogues of the female hormone progesterone. Sponsored by women's rights activist Katharine McCormick, Pincus used the discoveries of Djerassi as a blueprint for developing a practical oral contraceptive.

Pincus, leading a team of researchers, generated a series of experiments proving that progestin, a synthetic form of the female hormone progesterone, prevented ovulation in animals. After they completed successful testing on humans, the FDA approved the distribution of Enovid®, the first birth control pill, in 1960.

The cultural impact of the Pill is wide-reaching, allowing women the liberty of choosing a method of birth control that can be administered in the privacy of their own homes. The Pill is still commonly used today with 98% effectiveness.

Pincus was born in Woodbine, New Jersey, and studied biology at Cornell and Harvard Universities, earning his Ph.D. at the latter in 1927. Revered as the father of the Pill, Pincus was a pioneer in biotechnology.


Photo Credit: Courtesy of Kaman Corporation

Charles H. Kaman

Rotor Control Mechanism for Aircraft of Rotary Wing Type

Patent No. 2,668,595

Born June 15, 1919
Died January 31, 2011

Inducted in 2003

Aviation pioneer, entrepreneur, visionary, and humanitarian are all words that have been used to describe Charles H. Kaman.

Born in Washington, D.C. in 1919, Kaman graduated magna cum laude from Catholic University in 1940 with a bachelor's in aeronautical engineering. He began his aviation career with Hamilton Standard designing rotor blades for Igor Sikorsky. At the same time he was developing his own ideas about vertical flight. One of these was a design for a servo-controlled rotor system to improve stability and reduce pilot workload, a concept around which he started his own company, Kaman Corporation, in 1945. He went on to pioneer other firsts, including the gas turbine-powered helicopter and the remotely controlled helicopter. His H-43 Husky helicopter set numerous altitude and rate of climb records and was the forerunner of his K-MAX "aerial truck," the first helicopter designed for highly repetitive external lift operations.

His humanitarian service revolved around founding the Fidelco guide dog school in the early 1960s, which has opened new worlds of opportunity for the visually impaired. His numerous honors include the Wright Brothers Memorial Trophy and the National Medal of Technology.

Photo credit: Dr. George Stibitz Collection

George R. Stibitz

Complex Computer

Patent No. 2,668,661

Born April 30, 1904
Died January 31, 1995

Inducted in 1983

George R. Stibitz is recognized as the father of the modern digital computer. Born in York, Pennsylvania, Stibitz attended Moraine Park, an experimental school in Dayton, Ohio, and graduated from Denison University in 1926 with a Bachelor in Philosophy. He received an M.S. from Union College in 1927 and a Ph.D. in physics fromCornell in 1930. Stibitz joined Bell Telephone Laboratories in 1930.

Following World War II, he was an independent consultant for various government and industrial agencies. In 1964 he joined the Department of Physiology at Dartmouth Medical School as a research associate and became a professor in 1966 and professor emeritus in 1970.

Stibitz's interest in computers arose from an assignment in 1937 to study magneto-mechanics of telephone relays; he turned his attention to the binary circuits controlled by the relays, to the arithmetic operations expressible in binary form, and, in November 1937, to the construction of a two-digit binary adder. The next year he developed a full-scale calculator for complex arithmetic.

Several binary computers of greater sophistication followed, which introduced the excess 3 code, floating decimal arithmetic, self-checking circuits, jump program instructions, taped programs, and "table-hunting" subcomputers.

Photo credit: *Teleplex, Inc., Alford Division, Indianapolis, Indiana*

Andrew Alford

Localizer Antenna System

Patent No. 2,682,050

Born August 5, 1904
Died January 25, 1992

Inducted in 1983

Andrew Alford invented and developed antennas for radio navigation systems, including VOR and instrument landing systems featuring the "Alford Loop."

Born in Samara, Russia, Alford graduated from the University of California in 1924 with an A.B. and rceived an honorary doctorate from Ohio University in 1975. He was employed with the Harvard University Radio Research Lab from 1943 to 1945; was division head, Director Finder and Antenna Division, ITT, from 1943 to 1945; was head, Air Navigation Lab, International Telegraph Development Corporation, 1938-41; was with Mackay Radio and Telegraph Company, 1934-41; did engineering work for Fox Film Corporation, 1929-31; and was on the sound lab staff at California Institute of Technology, 1927-28. He later founded the Alford Manufacturing Company.

Photo credit: Courtesy of Searle

Frank B. Colton

Estradiene Compounds

Patent Nos. 2,691,028; 2,725,389

Born March 3, 1923
Died November 25, 2003

Inducted in 1988

Frank B. Colton developed Enovid, the first oral contraceptive. Born in Poland, Colton immigrated to the United States in 1934. He obtained his B.S. and M.S. degrees in chemistry from Northwestern University in 1945 and 1946 and his Ph.D. from the University of Chicago in 1950.

Between 1949 and 1951 Colton was a research fellow at the Mayo Foundation where he was associated with the Nobel Laureate Edward C. Kendall and helped develop an improved synthesis of cortisone. Colton joined G.D. Searle and Company in 1951 as a senior research chemist and after a series of more progressively responsible positions retired in 1986 as research adviser. Colton has made many important contributions to medicinal organic chemistry and particularly to steroid chemistry.

His pioneering research on the relationship between structure and biological activity, particularly of 19-nor steroids, led to the development of Nilevar, the first orally active anabolic agent which had a distinct separation between protein building and masculinizing properties. Of even greater importance was his research which resulted in the discovery of Enovid. The introduction of this substance in 1960 for family planning purposes ushered in the era of oral contraception.

1955-1964
New Pathways

By the 1950s, inventors were no longer public icons, but their work continued to change people's lives. The integrated circuit replaced transistors, expanding the move toward microelectronics. The new microchip technology was incorporated into everything from computers to wristwatches. At the same time, the laser found multiple applications in industry, medicine, and communications. Increased understanding of the architecture of DNA dramatically changed the study of genetics. Pharmaceutical research flourished as well, and drug manufacturing became one of the largest industries in the United States. Each discovery brought new opportunities to people who ventured into complex scientific and technological fields, and inventors needed advanced training to build on those opportunities. Although self-supporting inventors continued to make breakthroughs, the movement of inventors into corporate, university, or government laboratories accelerated.

Photo credit: Amherst College Photo

Lloyd H. Conover

Tetracycline

Patent No. 2,699,054

Born June 13, 1923

Inducted in 1992

Lloyd Conover invented tetracycline in 1952. Following its commercialization in 1953, it quickly became the most prescribed broad spectrum antibiotic. Tetracycline remains a drug of choice for a number of serious bacterial infections.

Born in Orange, New Jersey, Conover received his A.B. from Amherst College in 1947 and a Ph.D. from the University of Rochester in 1950. He joined a small Pfizer Research team exploring the chemistry of antibiotics Terramycin and Aureomycin. It was believed that altering its molecular structure would destroy the therapeutic activity of an antibiotic — a substance produced by a microorganism. Conover's discovery of tetracycline by chemical transformation of Aueromycin opened a new avenue of antibiotic research; most subsequent antibiotic discoveries have been made by chemical modification of prototype antibiotics.

With co-inventors W.C. Austin and J.W. McFarland, Conover also patented pyrantel, a drug used for the treatment of human and animal worm infestations. Pfizer chemists, directed by Conover, also discovered the antiprotozoal drug tinidazole, the antibiotic indanylcarbenicillin and the animal anti-infective/growth promotant carbodox.

Conover became director of Pfizer's U.K. research laboratories in 1971. He retired as a Senior Vice President of Pfizer Central Research in 1984.

Photo credit: Courtesy of the National Library of Medicine

John Gibbon

Oxygenating Unit for Extracorporeal Circulation Devices

Patent No. 2,702,035

Born September 29, 1903
Died February 5, 1973

Inducted in 2004

Dr. John Gibbon developed a heart-lung machine that he used in 1953 to successfully complete the first open-heart operation. Because of the development of the heart-lung machine, surgeons were able to perform surgeries previously considered too risky. Improved versions of the heart-lung machine allow surgeons today to repair heart defects and damaged heart valves, and to perform bypass surgery and heart transplants.

In 1930, after witnessing the death of a patient from a pulmonary embolectomy, Gibbon conceived the idea of a machine that could support cardiac and respiratory functions during surgical procedures to repair defects in the heart and lungs. Over the next decade, Gibbon and his wife Mary developed experimental devices that allowed them to successfully maintain complete pulmonary cardiac bypass in cats for 25 minutes. In the late 1940s, Gibbon persuaded IBM President Thomas J. Watson to provide him with the technical expertise needed to produce a more sophisticated device.

John Heysham Gibbon was born in Philadelphia and was a fourth generation physician. He received his A.B. from Princeton University in 1923, and his M.D. from Jefferson Medical College of Philadelphia in 1927.

Photo credit: IEEE

Gordon Teal

Method of Producing a Semiconductor Element

Patent No. 2,703,296

Born January 10, 1907
Died January 7, 2003

Inducted in 2009

Gordon Teal began his career in 1930 concentrating on better vacuum tubes at Bell Laboratories, but he would end it as the builder of the first commercial silicon transistor.

While with Bell Labs, Teal made himself an expert on how to grow the purified, perfect germanium crystals that were essential to the improved transistors then being designed by his colleague, William Shockley. His other achievements at Bell Labs resulted in 45 patents. In 1952, missing his hometown, Teal eagerly returned to Dallas to establish the Central Research Laboratories at Texas Instruments. He brought with him his method for "pulling" crystals, which by then included purified silicon. By the time Teal announced his working silicon transistors at a 1954 meeting, Texas Instruments had already begun production, skyrocketing the company – and the silicon semiconductor industry – to success.

Teal earned a bachelor's degree from Baylor University in 1927 and a Ph.D. from Brown in 1931. He left Texas Instruments in 1965 to become the first director of the National Bureau of Standards materials research division, but returned in 1967. After his retirement in 1972, Teal acted as a consultant to Texas Instruments.

Photo credit: The Department of Special Collections, the University of Chicago Library

Enrico Fermi

Neutronic Reactor

Patent No. 2,708,656

Born September 29, 1901
Died November 28, 1954

Inducted in 1976

While studying the creation of artificially radioactive isotopes in the 1930s, Enrico Fermi became the first physicist to split the atom. His later research pioneered nuclear power generation.

Born in Rome, Italy, Fermi graduated from the University of Pisa in 1922, became a lecturer at the University of Florence for two years, and then a professor of theoretical physics at Rome. In 1934 he perfected his theory of beta ray emission in radioactivity, and went on to study the creation of artificially radioactive isotopes through neutron bombardment. His bombardment of uranium with slow neutrons caused reactions which were found later to be atomic fission.

With researcher Leo Szilard, he began work, first at Columbia then at the University of Chicago, on construction of an atomic pile which would make possible the controlled release of nuclear energy. This was accomplished in 1942. Transferred for a time to the Los Alamos, New Mexico atomic bomb laboratory, Fermi returned to Chicago in 1945 as a professor at the Institute for Nuclear Studies and in the same year became a United States citizen.

He was awarded the Nobel Prize for physics in 1938 for his developments in harnessing nuclear power. Fermi is considered one of the most important architects of the nuclear age.

Photo credit: Erica Anderson

Leo Szilard

Neutronic Reactor

Patent No. 2,708,656

Born February 11, 1898
Died May 30, 1964

Inducted in 1996

Leo Szilard, working with Enrico Fermi, was awarded a patent for the nuclear fission reactor in 1955. He made significant contributions to the fields of statistical mechanics, nuclear physics, nuclear engineering, genetics, molecular biology, and political science.

Szilard was born in Budapest,Hungary; during World War I, he was drafted into the Austro-Hungarian army, interrupting his studies at the Budapest Institute of Technology. After the war, he received his doctorate from the University of Berlin. Szilard left Germany in 1933 and ultimately came to the United States. He knew that fission was the key to releasing nuclear energy.

On December 2, 1942, in Chicago, Szilard and Fermi set off the first controlled nuclear chain reaction. Szilard fully understood the implications of nuclear fission, and it was he who coordinated the letter sent to President Roosevelt from Einstein encouraging the establishment of the Manhattan Project. Interested in public policy and possessing a strong social consciousness, he also started the movement for the civilian control of atomic energy in 1945. Eventually, he gained Soviet Premier Khruschev's personal assent to a "hot line" between the US and the USSR to prevent nuclear war.

Photo credit: Estate of Dr. An Wang

An Wang

Pulse Transfer Controlling Device

Patent No. 2,708,722

Born February 7, 1920
Died March 24, 1990

Inducted in 1988

An Wang made many contributions to the advancement of computer technology, including the magnetic pulse controlling device, the principle upon which magnetic core memory is based. Born in Shanghai, China, Wang came to the United States in 1945. He received his B.S. from Chiao Tung University in Shanghai in 1940 and his Ph.D. in applied physics from Harvard University in 1948. He did postdoctoral work at the Harvard Computation Laboratory. He founded Wang Laboratories in 1951 to develop specialty electronic devices.

In 1965 he introduced LOCI, a desk top computer. This forerunner of the Wang electronic desk calculators used a keyboard like that of an adding machine but offered the unique feature of generating logarithms with a single keystroke. Every year since the production of the first LOCI, Wang Labs engineers have conceived and designed electronic instruments and systems, maintaining a steady progression of innovations in the office automation and information processing field.

At his death, Wang was chairman of the board and CEO of Wang Labs and held over 35 patents relating to computer technology.

Photo credit: ©2002 Jim Coit, Black Star

Ivan Getting

Remote Control System With Position Indicating Means

Patent No. 2,709,773

Born January 18, 1912
Died October 11, 2003

Inducted in 2004

The technological triumph known as GPS—the Global Positioning System of satellite-based navigation—was incubated in the mind of Ivan Getting. While serving as the vice president of research and engineering at the Raytheon Corporation during the 1950s, Getting advanced the concept of using an advanced system of satellites to allow the calculation of exquisitely precise positioning data for rapidly moving vehicles, ranging from cars to missiles.

Turning Getting's concept into reality required a massive financial commitment from the government, but the resulting technology makes possible a wide range of military and civilian uses that continue to grow rapidly. Getting also made significant contributions to the early development of radar, to space programs including Projects Mercury and Gemini, and to the creation of powerful chemical-based lasers.

Born in 1912 in New York City, Getting earned a B.S. from the Massachusetts Institute of Technology in 1933, then attended Oxford University as a Rhodes Scholar, receiving a Ph.D. in astrophysics in 1935. He received numerous awards during his life, including the Presidential Medal of Merit.

Photo credit: Courtesy of Academy of Applied Science

Robert Rines

Electric System; Microwave Scanning System; Sound Ranging System

Patent Nos. 2,711,534; 2,711,440; 2,528,725

Born August 30, 1922
Died November 1, 2009

Inducted in 1994

Robert H. Rines' contributions to radar and sonar began at the Massachusetts Institute of Technology's Radiation Laboratory with modulation techniques for the Microwave Early Warning System developed secretly during World War II. His patents underlie nearly all the high-definition image-scanning radar used to provide early-warning, weapons fire-control, and some artillery and missile detection radars during the Persian Gulf war. His inventions were instrumental in locating the Titanic and the Bismarck and are also used in medical instrumentation for noninvasive ultrasound imaging of internal organs.

In 1972, Rines performed a scientific sonar search for the Loch Ness monster. Born in Boston, Rines earned a B.S. in physics from M.I.T. and a law degree from Georgetown in 1946 focusing on patent law. In 1972 he completed a Ph.D. thesis at Chiao Tung University in the Republic of China. Rines, who held more than 80 patents, also wrote music for more than ten Broadway and off-Broadway shows.

He was Gordon McKay Lecturer on Patent Law at Harvard and Lecturer on Invention, Patents, and Innovation at M.I.T. He served on the Technical Advisory Board of the U.S. Department of Commerce. He founded both the Academy of Applied Science stimulating innovation in children and adults and the Franklin Pierce Law Center in New Hampshire.

Photo credit: Courtesy of the de Mestral Family

George de Mestral

Velvet Type Fabric and Method of Producing the Same

Patent No. 2,717,437

Born June 19, 1907
Died February 8, 1990

Inducted in 1999

In 1955, George de Mestral patented VELCRO® hook and loop fasteners, an efficient way to fasten fabrics and other materials. The idea came to him after observing the way a burr's barbed hooks clung to clothing. He found the logistics of attaching hundreds of tiny hooks to cloth tape to be a challenge, but eventually his hook and loop fastener was manufactured as VELCRO®, derived from the French words *velour* (velvet) and *crochet* (hooks).

VELCRO® fasteners have provided society with a practical and effective tool. Although most hook and loop tapes are nylon-based, there are also varieties made from plastic, stainless steel, and silver-impregnated substances for electrical applications. Touch fasteners are used in clothing, aircraft, office equipment, and sporting and leisure equipment. They are also used in the automotive and medical industries, nuclear engineering, and NASA's space program.

De Mestral was born in a small village near Lausanne, Switzerland. By working odd jobs, he paid his way through the Ecole Polytechnique Federale de Lausanne, where he graduated as an electrical engineer. He began his own company to manufacture VELCRO® fasteners, and later sold it and all patent rights. Today, the Velcro companies continue to manufacture touch fasteners and other products.

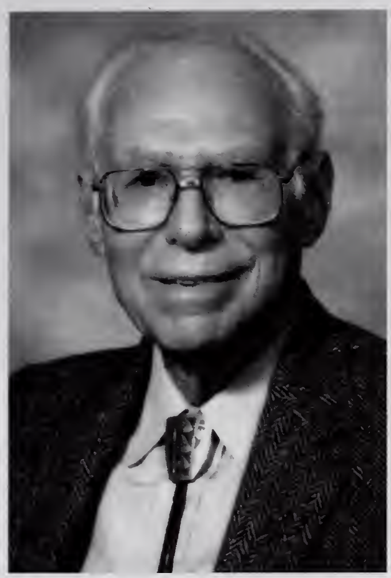

Photo Credit: Louis Fabian Bachrach©

John Pierce

Non-Synchronous Time Division Multiplex Telephone Transmission

Patent No. 2,719,188

Born March 27, 1910
Died April 2, 2002

Inducted in 2003

John Pierce invented the first communications satellite, enabling radio waves to bounce from one ground-based station to another. Pierce learned from the success of his design with Echo 1– a large aluminum sphere acting as a mirror, reflecting radio waves. Two years later, he launched Telstar 1, the world's first active communications satellite.

Pierce worked the majority of his life at AT&T Bell Laboratories, designing numerous electronic devices. The launch of Sputnik, the Soviet satellite, intrigued Pierce, and he calculated that 25 or so satellites could bounce signals around the globe, providing continuous communication. Telstar 1 came in 1962, carrying phone calls and television signals between America and Europe. An man of many interests, towards his later years Pierce became a professor of music at Stanford University. He enjoyed composing computer-generated music, providing early grounds for the synthesizer. Pierce was also a prolific author, writing or contributing to twenty books and more than 300 papers; under the pseudonym J.J. Coupling, Pierce wrote numerous science fiction novels, stemming from as early as 1930.

Granted over 90 patents, Pierce has been awarded the Edison Medal, the National Medal of Science, and the Charles Stark Draper Prize.

Photo credit: Courtesy of the Bennett Family

Willard H. Bennett

Radio Frequency Mass Spectrometer

Patent No. 2,721,271

Born June 13, 1903
Died September 28, 1987

Inducted in 1991

Willard Harrison Bennett pioneered the field of plasma physics and invented the radio frequency mass spectrometer. Born in Findlay, Ohio, Bennett attended Carnegie Institute of Technology and Ohio State University. He received his master's from the University of Wisconsin in 1926 and his Ph.D. from the University of Michigan in 1928. In 1930 he joined the Physics faculty at Ohio State.

Following service in World War II, Bennett worked at the National Bureau of Standards, the University of Arkansas, and the U.S. Naval Research Laboratory. In 1961, he was appointed Burlington Professor of Physics at North Carolina State University (emeritus in 1976). Bennett made scientific history in the 1930s pioneering studies in plasma physics. These studies have been used throughout the world in controlled thermonuclear fusion research.

In the 1950s, Bennett's experimental tube called the Stormertron predicted and modeled the Van Allen radiation belts surrounding the earth six years before they were discovered by satellite. It also reproduced intricate impact patterns found on the earth's surface which explained many features of the polar aurora. The radio frequency mass spectrometer was developed in 1950. It was first launched into space on the Sputnik III to measure the masses of atoms. It was the only space instrument used by the Russians and credited to an American inventor in their own Russian-language publications.

Photo credit: Courtesy of MITRE Corporation Archives

Jay W. Forrester

Multicoordinate Digital Information Storage Device

Patent No. 2,736,880

Born July 14, 1918

Inducted in 1979

Jay W. Forrester was a pioneer in early digital computer development and invented random-access, coincident-current magnetic storage, which became the standard memory device for digital computers.

Born in Climax, Nebraska, Forrester lived on a Nebraska cattle ranch until he entered the University of Nebraska, where he received a B.S. degree in Electrical Engineering in 1939. Forrester received an M.S. degree from the Massachusetts Institute of Technology in 1945.

Following his work in computers, Forrester turned his attention to societal systems. The field of system dynamics was created in 1956 under his leadership to evaluate how alternative policies affect growth, stability, fluctuation, and changing behavior in corporations, cities, and countries.

Forrester has received nine honorary degrees. He is now professor emeritus of management of the Systems Dynamics Group at the Alfred P. Sloan School of Management at M.I.T.

Photo credit: Mary Carson

Carl Djerassi

Δ4 -19-NOR-17α–ethinylandrosten–17β – OL–3–One and Process

Patent No. 2,744,122

Born October 29, 1923

Inducted in 1978

Carl Djerassi is recognized for his breakthroughs in chemistry and for his effective translation of theory into practice. His achievements include establishing physical methods for determining organic molecular structure and the synthesis of many steroids. His work led to oral contraceptives, antihistamines, and anti-inflammatory agents.

Born in Vienna, Austria, Djerassi graduated from Kenyon College with an A.B. degree in 1942 and received his Ph.D. from the University of Wisconsin in 1945. He was a research chemist from 1942 to 1952 and professor at Wayne State University from 1952 to 1959.

He became a chemistry professor at Stanford University in 1959. Djerassi is widely known for his contributions to synthetic organic chemistry and to physical methods of determining organic molecular structure, his effectiveness in translating scientific knowledge into technological practice, and his efforts to promote international scientific cooperation.

His research is in such diverse fields as chemistry of steroids; structure of alkaloids, antibiotics and terpenoids; synthesis of drugs, particularly antihistamines, oral contraceptives, and anti-inflammatory agents; optical rotatory dispersion studies, organic mass spectrometry, and magnetic circular diehroism of organic compounds. He has lectured extensively on birth control issues.

Photo credit: DePauw University Archives and Special Collections

Percy Lavon Julian

Preparation of Cortisone

Patent No. 2,752,339

Born April 11, 1899
Died April 19, 1975

Inducted in 1990

Percy Lavon Julian synthesized physostigmine for treatment of glaucoma and cortisone for the treatment of rheumatoid arthritis. He is also noted for a fire-extinguishing foam for gasoline and oil fires. Born in Montgomery, Alabama, Julian had little schooling because Montgomery provided limited public education for blacks. However, he entered DePauw University as a "sub-freshman" and graduated in 1920 as class valedictorian. He then taught chemistry at Fisk University, and in 1923, earned a master's degree from Harvard University. In 1931, Julian received his Ph.D. from the University of Vienna.

He returned to DePauw University, where his reputation was established in 1935 by synthesizing physostigmine from the calabar bean. Julian went on to become director of research at the Glidden Company, a paint and varnish manufacturer. He developed a process for isolating and preparing soy bean protein, which could be used to coat and size paper, to create cold water paints, and to size textiles. During World War II, Julian used a soy protein to produce "AeroFoam" which suffocates gasoline and oil fires.

Julian was noted most for his synthesis of cortisone from soy beans, used in treating rheumatoid arthritis and other inflammatory conditions. His synthesis reduced the price of cortisone.

Photo credit: © Ted Polumbaum

Charles Stark Draper

Gyroscopic Apparatus

Patent No. 2,752,790

Born October 2, 1901
Died July 25, 1987

Inducted in 1981

Aeronautical engineer and university professor Charles Stark Draper developed gyroscope systems that stabilized and balanced gunsights and bombsights, which were later expanded to an inertial guidance system for launching long-range missiles at supersonic jet targets. Born in Windsor, Missouri, Charles Draper disliked specialization and so took several degrees from Stanford, Harvard, and finally a Doctor of Sciences in Physics from the Massachusetts Institute of Technology in 1938.

Having already established his credentials as a scientist and educator at MIT, Draper was named head of the institute's Instrumentation Laboratory in 1939. There he developed a spinning gyroscope, stabilizing Navy antiaircraft gunsights. Success led to gyroscopic-balanced bombsights, which were later expanded to the inertial guidance system for missiles. Draper subsequently developed the Spatial Inertial Reference Equipment (SPIRE) system for automatic aeronautical navigation–a system he later refined and miniaturized for use in the Polaris submarine missile system.

He continued to be a pace-setter in the space age as head of MIT's renamed Department of Aeronautical and Astronautical Engineering. His Instrumentation Lab was awarded the Project Apollo contract for guiding man and spacecraft to the moon.

Photo credit: Courtesy of Harry W. Coover

Harry W. Coover

Alcohol-Catalyzed Cyanoacrylate Adhesive Compositions

Patent No. 2,768,109

Born March 6, 1917
Died March 26, 2011

Inducted in 2004

Harry Coover's discovery of cyanoacrylates, a class of chemicals with powerful adhesive properties, opened the door to a wide range of industrial, consumer, and medical applications, most notably as superglue. While working as a research chemist at Eastman Kodak during World War II, Coover worked with cyanoacrylates in an effort to produce an optically clear plastic to use for precision gunsights. These chemicals proved to be unsuited to this particular task, but Coover recognized their potential applications as an adhesive.

During the Vietnam War, field surgeons made dramatic use of cyanoacrylate by spraying it on potentially fatal wounds to stop bleeding instantly, thus allowing them to treat the wounds later in a conventional manner. Cyanoacrylate adhesives are currently used for medical procedures such as performing sutureless surgery to rejoin veins and arteries, sealing punctures or lesions, and sealing bleeding ulcers.

Harry Coover was born in Newark, Delaware. He received his B.S. from Hobart College and his M.S. and Ph.D. from Cornell University. Coover, who held 460 patents, was also responsible for advances in the fields of graft polymerization, organophosphorus chemistry, and olefin polymerization.

Retiring as Vice President of Eastman Kodak for R&D, Chemicals Division, he was president of the Industrial Research Institute, winning its medal in 1984 and its Achievement Award in 1999. Coover was also the recipient of the 2009 National Medal of Technology and Innovation.

Photo credit: Lockheed Martin

Clarence L. Johnson

Afterburning Means for Turbo-Jet Engines

Patent No. 2,771,740

Born February 27, 1910
Died December 21, 1990

Inducted in 2008

Clarence "Kelly" Johnson designed technologically advanced aircraft, including the United States' first operational jet fighter, the Lockheed F-80.

Born in Ishpeming, Michigan, Johnson knew he wanted to design airplanes by the time he was twelve. He attended Flint Junior College using money saved from his own earnings. He later studied aeronautical engineering at the University of Michigan, earning a B.S. in 1932 and an M.S. in 1933.

Hired by Lockheed Aircraft Corporation as a tool designer in 1933, Johnson rose to the position of chief research engineer by 1938. He designed or influenced dozens of aircraft in addition to the F-80, including the P-38 Lightning, one of the best fighter planes of World War II; the F-104, the first aircraft to hold speed and altitude records at the same time; and the SR-71, the first airplane with stealth technology. He also designed the U-2 high-altitude spy plane.

Also known for his managerial talent, Johnson created Lockheed's "Skunk Works," a team of engineers that designed advanced military aircraft and became known for some of the company's most remarkable aviation technology. He retired as senior vice president in 1975 and continued to advise the company until his death.

Photo Credit: Reprinted with permission of Alcatel-Lucent

Daryl Chapin

Solar Energy Converting Apparatus

Patent No. 2,780,765

Born July 21, 1906
Died January 19, 1995

Inducted in 2008

Daryl Chapin, with Bell Labs colleagues Calvin Fuller and Gerald Pearson, invented the first practical device for converting sunlight into useful electrical power. Today, the silicon solar cell powers devices from hand held calculators to the Mars Rover.

Chapin was born in Ellensburg, Washington. He earned a bachelor's degree from Willamette University and a master's degree from the University of Washington. He joined Bell Labs in 1930, after teaching physics at Oregon State College for a year.

At Bell Labs, Chapin initially studied magnetic materials. During World War II, he focused on underwater sound devices and magnetic recording. In early 1953, in an effort to find new sources of power for transistor telephone systems, he began to investigate the direct conversion of solar energy into electrical energy. The solar battery was first demonstrated on April 25, 1954. In 1959, Chapin so simplified the process of making solar cells that it became one of Bell Systems' Science Experiments performed by high school students around the U.S.

Chapin was a Bell Labs scientist for over 40 years. After retiring, he was still fascinated with all forms of sunlight energy. From the solar panel that powered the electric fence around his garden to finding new uses for photovoltaic cells, that passion continued to the time of his death.

Photo Credit: Reprinted with permission of Alcatel-Lucent

Calvin Fuller

Solar Energy Converting Apparatus

Patent No. 2,780,765

Born May 25, 1902
Died October 28, 1994

Inducted in 2008

Chemist Calvin Fuller co-invented the silicon solar cell with physicists Daryl Chapin and Gerald Pearson. Building on Albert Einstein's theories about the photoelectric effect, the three scientists' solar battery has powered everything from the space program to the Internet.

Born in Chicago, Fuller received his B.S. and Ph.D. degrees in physical chemistry from the University of Chicago. He joined Bell Labs in 1930, where his work included research in organic insulating materials and investigations of the molecular nature of polymers. Beginning in 1948, Fuller's research focused on semiconductors and the development of semiconductor devices. His work yielded a method of diffusing impurities into the surface of a silicon wafer, a technique fundamental to producing the solar battery and other silicon devices.

The solar cell is composed of an array of thin silicon wafers that contain minute traces of boron, which creates electrical charges when stimulated by light. The solar cell helped advance the space program by allowing space vehicles to utilize readily-available sunlight. And, reversing the cell's process and converting electrical signal into light allows data to be carried via the fiber optic lines that transmit information across the Internet.

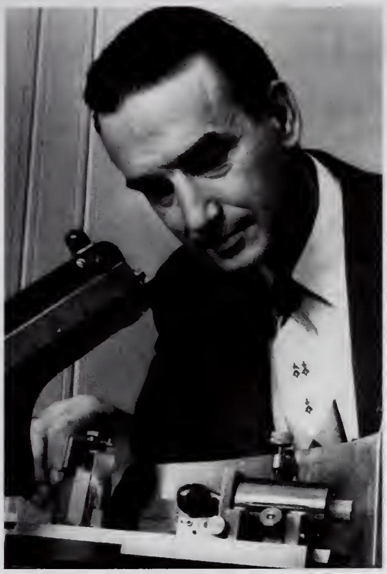

Photo Credit: Reprinted with permission of Alcatel-Lucent

Gerald L. Pearson

Solar Energy Converting Apparatus

Patent No. 2,780,765

Born March 31, 1905
Died October 25, 1987

Inducted in 2008

Gerald Pearson's fundamental research in semiconductor materials led to theinvention, with Daryl Chapin and Calvin Fuller, of the silicon solar cell—the first practical device that converted solar energy into electrical power.

Pearson was born in Salem, Oregon. He earned a bachelor's degree in mathematics and physics from Willamette University, and a master's degree in physics from Stanford University. He began his career in 1927 as a research physicist with Bell Labs. His early work there on temperature-sensitive resistors led to thirteen patents and had an important impact on the telecommunications industry.

Shifting the focus of his research at Bell Labs to semiconductor materials, Pearson carried out a series of experiments that were essential to the development of models of semiconductor behavior. His work on silicon rectifiers—electronic components that control electrical current—led to the invention for which he is best known, the silicon solar cell, which became the power source of satellite communications and numerous other applications.

After retiring from Bell Labs, Pearson returned to Stanford, where he set up one of the first university programs in compound semiconductor research. He actively continued his work until the age of 78.

Photo credit: Courtesy of the Higonnet Family

René Alphonse Higonnet

Photo Composing Machine

Patent No. 2,790,362

Born April 5, 1902
Died October 13, 1983

Inducted in 1985

René Alphonse Higonnet and Louis Moyroud introduced the first phototypesetting machine that used photocomposition. Photocomposition greatly reduced the cost and time necessary for creating the printed word. The first book composed by a phototypesetting machine was printed in 1953, titled *The Wonderful World of Insects*. Composed without metal type, it might someday rank in the historical importance of printing with the first book printed from moveable type, the Gutenberg Bible. In fact, two original photocomposing machines are on display in the Gutenberg Museum in Germany.

René Higonnet was born in Valence, Drome, France. The son of a teacher, he was educated at the Lycée de Tournon and the Electrical Engineering School of Grenoble University. He was granted a scholarship by the International Institute of Education in New York in 1922, went to Carleton College in Minnesota for one year, and subsequently spent one term at the Harvard Engineering School. He was an engineer with the Materiel Telephonique, a French subsidiary of ITT, from 1924 to 1948. He then became a transmission engineer and worked on long distance cables in Paris-Strasbourg, London-Brussels, and Vienna-Budapest. He was also associated with the Patent and Information Department of ITT, and he received the Franklin Medal in 1955.

Photo credit: Courtesy of Louis M. Moyroud

Louis Marius Moyroud

Photo Composing Machine

Patent No. 2,790,362

Born February 16, 1914
Died June 28, 2010

Inducted in 1985

Louis Marius Moyroud and René Higonnet developed the first practical phototypesetting machine. This, along with Merganthaler's Linotype machine, is one of two major innovations created in type composition since Gutenberg's invention of movable type. Moyroud and Higonnet began work in 1944, and by 1946, they had completed their first prototype. They demonstrated their machine, the Lumitype—later known as the Photon—in September 1946 and introduced it to America in 1948. Photocomposition machines replaced metal type with a photographic image of the letters, under control from a keyboard or computer. Rather than a block of metal, the master copy is a piece of film.

Born in Moirans, Isere, France, Moyroud attended engineering school from 1929 to 1936 and graduated as an engineer from Ecole Nationale Superieure des Arts et Metiers of Cluny, France. He served in the military from 1936 to 1940. He joined the LMT Laboratories, a subsidiary in Paris of ITT, in 1941 and left in 1946 to spend all of his time on photocomposition. In 1955, he was a recipient of the Franklin Medal.

Moyroud was also instrumental in the development of the Euorcat Series of phototypesetting machines marketed in Europe by Bobst Graphics.

Photo credit: Reprinted with permission of Mississippi University for Women

Elizabeth Lee Hazen

Nystatin and Method of Producing It

Patent No. 2,797,183

Born August 24, 1885
Died June 24, 1975

Inducted in 1994

Elizabeth Lee Hazen and Rachel Brown created the first useful antifungal antibiotic, nystatin, through a long-distance scientific collaboration. As researchers for the New York State Department of Health, Hazen in New York City and Brown in Albany shared tests and samples through the U.S. mail. The antibiotic they developed, named "nystatin" for the New York State Department of Health, was introduced in practical form in 1954 following FDA approval.

Not only did it cure many disfiguring and disabling fungal infections, but it could be combined with antibacterial drugs to balance their effects. Uses for nystatin have been as varied as treating Dutch elm disease to rescuing water-damaged works of art from molds. Hazen and Brown donated their royalties, more than $13 million, to academic science through the nonprofit Research Corporation.

Born in Mississippi, Hazen was orphaned at the age of three and raised by relatives. She earned a B.S. at the Mississippi State College for Women, and an advanced degree in bacteriology from Columbia University. She began work for New York State in 1931.

Photo credit: Courtesy of Research Corporation, A Foundation for the Advancement of Science

Rachel Fuller Brown

Nystatin and Method of Producing It

Patent No. 2,797,183

Born November 23, 1898
Died January 14, 1980

Inducted in 1994

In 1948, Rachel Fuller Brown and Elizabeth Hazen began work on an antifungal project, leading to the introduction of the antibiotic nystatin in 1954. Earlier this century, broad-spectrum antibiotics were used more and more often. The antibiotics were so potent that they killed a wide variety of bacteria and were so thorough that no healthy bacteria were left to keep fungi under control.

Brown tried to find specific antifungal agents from samples Hazen sent. Once these agents were identified, Hazen performed further testing. Nystatin proved invaluable for secondary infections caused by broad-spectrum antibiotics, for restoring mildewed paintings, and for controlling skin lesions and eye infections in turkeys and chickens. The royalties from nystatin amounted to millions, and Brown and Hazen gave it all to science.

Brown was born in Springfield, Massachusetts. She received her undergraduate education at Mount Holyoke College and earned M.A. and Ph.D. degrees in chemistry from the University of Chicago. At the New York State Division of Laboratories and Research, she found a faster, less expensive screening test for syphilis, identified 40 types of pneumonia, and created antiserums for all of them. She became a pioneer in encouraging women to study science.

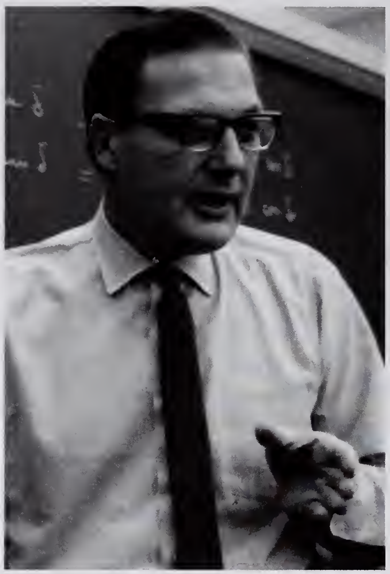

Photo credit: The Hewlett-Packard Company

Bernard Oliver

Communication System Employing Pulse Code Modulation

Patent No. 2,801,281

Born May 27, 1916
Died November 23, 1995

Inducted in 2004

Bernard Oliver, one of the most prolific and influential inventors of his generation, helped give birth to the era of digital information with his invention of ``pulse code modulation," or PCM. This allowed information of all kinds to be translated into the digital language of binary code, then transmitted to receivers capable of manipulating the information or restoring it to its original form. Today, PCM is an integral part of much of the digital technology that defines the modern world.

Other highlights in Oliver's prolific career include his development of early forms of radar, pioneering work in television technology, practical handheld calculators, and visionary work using radio telescopes to search space for signals from extraterrestrial civilizations. In his later years, Oliver made large financial contributions to support scientific research, higher education, and cultural institutions.

Born in Soquel, California, Oliver completed a B.A. in electrical engineering at Stanford University when he was 19. A year later he received an M.S. from Caltech, where he earned a Ph.D., graduating magna cum laude at the age of 24. He earned a reputation as a brilliant inventor at Bell Laboratories before creating the research and development department at Hewlett-Packard, where he remained until his retirement.

Photo credit: Property of AT&T Archives. Reprinted with permission of AT&T.

Claude Shannon

Communication System Employing Pulse Code Modulation

Patent No. 2,801,281

Born April 30, 1916
Died February 24, 2001

Inducted in 2004

Claude Shannon produced one of the great conceptual breakthroughs of his generation with the publication of his seminal work, "A Mathematical Theory of Communication". It laid the foundations of information theory, explaining that binary digits—which he first called ``bits"—could carry information in a digital form. This radical idea led directly to the wide range of digital inventions so common today, from cell phones and CDs to cameras and computers. By showing how information could be manipulated in a precise, mathematical way, he gave engineers what experts have called "a blueprint for the digital age."

Shannon was born in Gaylord, Michigan. He earned his B.S. degree from the University of Michigan in 1936; he then went on to MIT, where he received an M.S. in electrical engineering and a Ph.D. in mathematics. While at MIT, he worked under Vannevar Bush on the differential analyzer, an early analog device that was the most powerful computer of its day, but ultimately made obsolete by the more powerful digital devices envisioned by Shannon. Shannon joined the mathematics department at Bell Labs in 1941 and remained affiliated with Bell Labs until 1972. He became a visiting professor at MIT in 1956, a permanent member of the faculty in 1958, and a professor emeritus in 1978. He was the recipient of many honors, including the Institute of Electrical and Electronics Engineers Medal of Honor, the Kyoto Prize and the National Medal of Science.

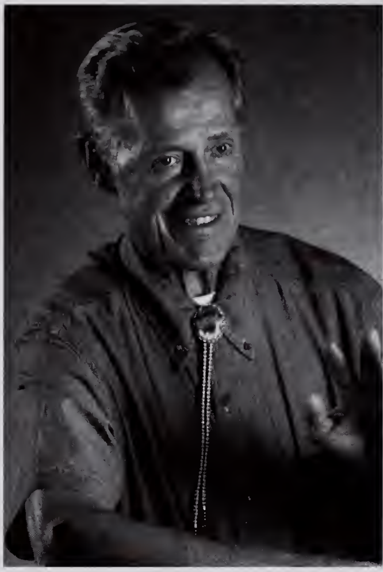

Photo credit: Xerox Corporation

Robert Gundlach

Multiple Copy Transfer Process and Apparatus

Patent No. 2,812,709

Born September 7, 1926
Died August 18, 2010

Inducted in 2005

Robert Gundlach made photocopying technology more practical, flexible, and affordable. As one of the first research scientists hired at the Haloid Company, now known as the Xerox Corporation, Gundlach was responsible for finding ways to refine and improve xerography. The first commercial copy machines were the size of a desk, operated slowly, and produced copies of marginal quality.

Gundlach devoted over three decades to the task of transforming the machines into the small, robust products that revolutionized xerography. He created three patentable inventions during his first year at Xerox, including an idea that allowed photocopiers to reproduce solid shapes, making copies more universally acceptable. As xerography advanced, Gundlach invented ways to produce color copies and use digital technology. His most lucrative patent at Xerox enabled photocopiers to print two-colored images.

Born in Buffalo, New York, Gundlach graduated from the University of Buffalo in 1949. He earned more than 150 patents and was the first research fellow at Xerox. Although most of his inventions related to xerography, he also received patents for a snow-making machine, a comfortable backpack, and a water-based heat pump.

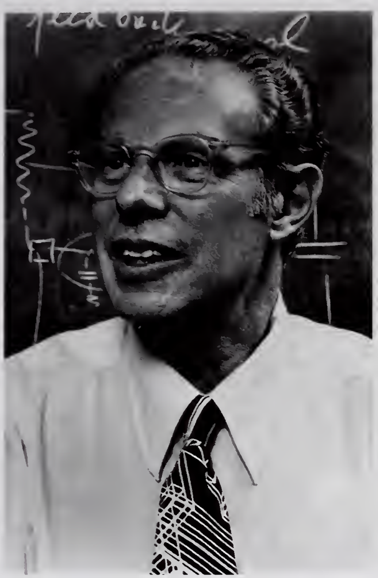

Photo Credit: LG Electronics

Robert Adler

Control System

Patent No. 2,817,025

Born December 4, 1913
Died February 15, 2007

Inducted in 2008

Robert Adler invented the first practical, wireless television remote control. Introduced as the "Space Command" by Zenith in 1956, Adler's device was sold with more than nine million televisions before the advent of infrared technology in the 1980s.

Born in Vienna, Austria, in 1913, Adler received a Ph.D. in Physics from the University of Vienna in 1937. He joined Zenith Electronics' U.S. research division in 1941 and specialized in military communications equipment during World War II. After the war, he focused on television technology. He invented the gated-beam vacuum tube, which substantially reduced sound interference, and led a team that invented a special circuit that improved reception.

In the early 1950s, television remote controls relied on cumbersome cords, or light beams pointed at photo cells in the television cabinet—photo cells which also reacted to sunlight. Adler's solution was to use ultrasound, or sound waves above the range of human hearing. The buttons on his device struck one of four aluminum rods inside the unit, which produced tones the television recognized as "channel-up," "channel-down," "sound on/off," or "power on/off."

Over the next quarter century, the ultrasound remote control became standard equipment for television viewing.

Photo credit: John Parsons Collection

John T. Parsons

Motor Controlled Apparatus for Positioning Machine Tool

Patent No. 2,820,187

Born October 11, 1913
Died April 18, 2007

Inducted in 1993

John Parsons changed the control of machines and industrial processes from an imprecise craft to an exact science, spawning a second industrial revolution. Born in Detroit, Parsons received the first honorary Doctor of Engineering awarded a manufacturing engineer by the University of Michigan. Parsons' accomplishments spanned 60 years of creative problem solving. From his first job as a stamping plant piece-worker and then a tool room apprentice, he sought to affect and improve all phases of manufacturing, from new materials to new ways to settle labor negotiations.

His greatest gift was the invention of numerical control, which Parsons conceived and implemented with the help of his aircraft engineer Frank L. Stulen. It consisted of the complex formulae used in structural and aerodynamic design of helicopter rotor blades and other structures. Parsons also pioneered adhesive bonding in metal aircraft structure, then built the first all-composite airplane. He produced the gigantic fuel lines for the Saturn booster that started the U.S. astronauts toward the moon, and he brought computers to aircraft design, manufacturing, and real-time management reporting.

Additionally, he developed Numerical Control-produced evaporative patterns to replace weldments and streamlined castings, which revolutionized the production of automobile body dies.

Photo credit: Phillips Petroleum Company

J. Paul Hogan

Polymers and Production Thereof

Patent No. 2,825,721

Born August 7, 1919

Inducted in 2001

Paul Hogan was working with Robert Banks at Phillips Petroleum in 1951 when they invented crystalline polypropylene and a breakthrough process for making high-density polyethylene (HDPE). These substances revolutionized the plastics industry because they were stronger and more heat-resistant than other plastics and could be made in a low-pressure process. Polypropylene and high-density polyethylene were manufactured and marketed by Phillips under the brand name Marlex®. Initially, it was difficult to mass-produce the materials and to gain the interest of consumer and industrial goods manufacturers.

In 1956, however, the Hula-Hoop craze swept America, and toy makers placed huge orders for Marlex®, giving momentum to the new plastics. Among the next products made were baby bottles for hospitals, because HDPE withstood the high heat of sterilization. Today, billions of pounds of polypropylene and HDPE are used annually to make packaging and containers, toys, tools, furniture, auto parts, tubing, carpet, pipes and many other products.

Hogan grew up in Lowes, Kentucky and received a degree in chemistry and physics from Murray State University. During World War II, he served as an instructor at a preflight school. He joined Phillips in 1944, working there until his 1985 retirement. His numerous awards include the Pioneer Chemist Award and the Society of Chemical Industry's Perkin Medal. Hogan holds 52 U.S. patents.

Photo credit: Phillips Petroleum Company

Robert Banks

Polymers and Production Thereof

Patent No. 2,825,721

Born November 24, 1921
Died January 3, 1989

Inducted in 2001

Robert Banks and fellow research chemist Paul Hogan were working for Phillips Petroleum in 1951 when they invented crystalline polypropylene and high-density polyethylene (HDPE). Together, the plastics were marketed under the brand name Marlex®, which has since made its way into every corner of American life. Banks and Hogan began working together in 1946. Low-density polyethylene already existed, but manufacturing it required extremely high pressures. While working on another project to improve yields of high-octane gasoline—the two chemists discovered crystalline polypropylene. They experimented further and found they were able to produce HDPE in a low pressure situation. Their discoveries launched a multi-billion dollar industry.

Today, over 55 billion pounds of HDPE are manufactured each year. Plastic products include gallon milk jugs, laundry baskets, indoor-outdoor carpeting, and artificial turf. Banks was born and raised in Piedmont, Missouri. He received his B.S. from the University of Missouri at Rolla and his M.S. from Oklahoma State University. During World War II, he was a process engineer at an aviation gasoline plant. In 1946 Banks joined Phillips, spending his career there until his 1985 retirement. In 1987, Banks received an honorary doctorate from the University of Missouri at Rolla.

Photo credit: Bayer Corporation, Elkhart, IN

Alfred H. Free

Composition of Matter

Patent No. 2,848,308

Born April 11, 1913
Died May 15, 2000

Inducted in 2000

Alfred Free revolutionized urinalysis by devising a dip-and-read test, Clinistix®, for detecting glucose in urine. Working at Miles Laboratories, he also advanced diabetes testing with the first one-minute test for blood glucose, leading to the concept of self-testing for persons with diabetes.

The Clinistix test, developed with his wife and fellow chemist Helen Free, was easier to use than previous tests. It was an especially important breakthrough in glucose testing because it made diabetes detection more convenient. Free and his group then devised convenient tests for kidney damage, liver dysfunction, and urinary tract infection, combining all on one reagent strip to give a complete chemical analysis in two minutes.

Free was born in Bainbridge, Ohio and received an A.B. degree from Miami University (Ohio). He then attended Western Reserve University in Cleveland, where he received his M.S. and Ph.D. After teaching for a number of years at Western Reserve, he joined Miles in 1946, where he stayed until his retirement in 1978.

Free published over 200 articles during his lifetime, many co-authored with his wife. Free also wrote two books with his wife, *Urodynamics* and *Urinalysis in Clinical Laboratory Practice*, both considered notable works in the field.

Photo Credit: The Journal of Commerce

Malcom McLean

Apparatus for Shipping Freight

Patent No. 2,853,968

Born November 14, 1913
Died May 25, 2001

Inducted in 2008

Malcom McLean invented containerized shipping, which transformed the shipping industry, in the 1950s. By the end of the twentieth century, container ships transported nearly 90 percent of the world's trade cargo.

The son of a farmer, McLean was born near Maxton, North Carolina. His education ended with high school. During the Great Depression, McLean bought a used truck and began hauling products for nearby farmers. Like other truckers, he chafed at the time lost as crates were loaded and unloaded between trucks and the holds of ships. In 1955, after building his trucking business into the fifth-largest fleet in the U.S., he sold it in order to capitalize on a revolutionary idea.

McLean designed containers that could be separated from the truck bed and wheels, were made of heavy steel to protect their contents, and could be neatly stacked. He acquired a fleet of old tankers and converted them to container ships. McLean's container system dramatically reduced time and labor costs, as well as pilfering and damage to cargo—which had the added benefit of lowering insurance rates.

McLean's improvements reduced the cost of shipping 25 percent. His new company, SeaLand Industries, became the largest cargo-shipping business in the world.

Photo credit: The MIT Museum

Charles Hard Townes

Production of Electromagnetic Energy; Masers and Maser Communications System

Patent Nos. 2,879,439; 2,929,922

Born July 28, 1915

Inducted in 1976

Charles Townes' invention of the maser, a device that amplifies electromagnetic waves, created a means for the sensitive reception of communications and for precise navigation. The maser provided basic components of the laser, for which Townes also received a patent.

Born in Greenville, South Carolina, Townes joined the technical staff of Bell Telephone Laboratories Inc. and worked on radar bombing systems during World War II. In 1948 he joined the faculty of Columbia University and three years later had the idea that culminated in construction of the maser.

From 1959 to 1961 Townes served as vice president and director of research of the Institute for Defense Analysis in Washington, D.C. He then was appointed provost and professor of physics at the Massachusetts Institute of Technology. The difference between a maser and a laser is that the laser utilizes visible light. Apart from being useful tools in the laboratory, both masers and lasers have found many applications in radar, communications, astronomy, navigation, atomic clocks, surgery, and industry. For his advances in the field of quantum electronics, Townes was awarded the 1964 Nobel Prize for Physics.

Photo credit: Glaxo Wellcome, Inc.

Gertrude Belle Elion

2-Amino-6-Mercaptopurine

Patent No. 2,884,667

Born January 23, 1918
Died February 21, 1999

Inducted in 1991

Gertrude Belle Elion invented the leukemia-fighting drug 6-mercaptopurine and drugs that facilitated kidney transplants. Born in New York City, Elion attended Hunter College and graduated summa cum laude in 1937. She received her M.S. in chemistry from New York University, and later received ten honorary doctorates.

Elion's early career included working as a high school teacher and as an analytical chemist. Hired by Burroughs-Wellcome in 1944, she began work on antagonists of nucleic acid building blocks. This led to the synthesis of 6-mercaptopurine, marketed as Purinethol, and to another antileukemic drug, 6-thioguanine. Her continued research led to Imuran, a derivative of 6-mercaptopurine that blocked the body's rejection of foreign tissues. Used with other drugs, Imuran enabled kidney transplants from unrelated donors. Elion and her team were also prominent in the development of allopurinol (trade name Zyloprim), for treatment of gout, and of an antiviral agent, acyclovir (Zovirax), which has been used to battle herpes virus infections.

In 1988, Elion shared the Nobel Prize in Medicine with George Hitchings and Sir James Black. In 1967, she was named Head of the Department of Experimental Therapy at Burroughs-Wellcome. Even after her retirement in 1983, she continued to work for the advancement of science.

Photo Credit: Courtesy of the Hans von Ohain Collection

Hans J.P. von Ohain

Fluid Machine

Patent No. 2,911,189

Born December 14, 1911
Died March 13, 1998

Inducted in 2003

On the brink of World War II, Hans von Ohain developed a working turbojet engine in Germany, helping to catapult the aeronautical world into the next generation. Although the country could not produce a good enough jet fighter soon enough to affect the War, von Ohain's contribution did change the aeronautical industry.

Born in Dessau, Germany, he earned a Ph.D. in Physics from the University of Göttingen in 1935. The following year, while still at Göttingen, von Ohain continued developing theory in the turbojet engine and built a working model. From 1936 through 1939, while working at the Heinkel Aircraft Company, von Ohain worked exhaustively on improving his earlier working model. On August 27, 1939, von Ohain marked his place in aviation history, watching the HeS-3B turbojet engine make its inaugural flight in the He 178 airplane at Heinkel Airfield.

Moving to America in 1947, he became the Chief Scientist at Wright-Patterson Air Force Base in Dayton, Ohio, developing visionary aeronautical concepts such as thrust augmentation, laser aerodynamics, and particle separation dealing with high-speed flows. Von Ohain received both the Charles Stark Draper Prize and the Daniel Guggenheim Medal in 1991.

Photo credit: Bayer Corporation, Elkhart, IN

Helen M. Free

Indicator for Detecting Glucose

Patent No. 2,912,309

Born February 20, 1923

Inducted in 2000

Helen Free is known as a pioneer in diagnostic chemistry. During her years at Miles Laboratories, her work led to the introduction of convenient dip-and-read urine tests, starting with Clinistix® in 1956. Clinistix, which aids diabetes monitoring by detecting glucose, led to a line of additional efficient and easy self-tests. These tests relate not only to urinalysis but also to blood chemistry. The procedures that Free developed with her husband and colleague Alfred Free are still used in laboratories worldwide.

Born in Pittsburgh, Pennsylvania, Free attended school at the College of Wooster (Ohio). She received a B.S. in chemistry in 1944 and an M.A. from Central Michigan University in 1978. After earning her bachelor's degree, she began work at Miles, known today as Bayer. Among her many accomplishments at Miles, she was the first woman scientist to reach an executive level. Although she retired in 1982, she continues to work as a consultant.

Free's high level of involvement with professional groups shows her dedication to her work. She has served as the president of both the American Association for Clinical Chemistry and the American Chemical Society. She is also involved in public outreach, promoting science education through programs around the world.

Photo credit: Courtesy of Corning Incorporated

S. Donald Stookey

Glass Ceramics

Patent No. 2,920,971

Born May 23, 1915

Inducted in 2010

Donald Stookey invented glass ceramics, materials that embodied important advances in glass technology and led to the popular CorningWare line of consumer dishes.

Among Stookey's contributions at Corning Glass Works was Fotoform glass, which could be photochemically etched into precise and detailed structures. In 1953, Stookey discovered that when he overheated the glass it became harder, stronger, and higher in electrical resistivity. This new crystalline material, called glass ceramic, opened a new field of high temperature chemistry in glass.

CorningWare, the revolutionary cookware and dishware, was first marketed in 1958. In addition to consumer products, glass ceramics have been used to make products such as nose cones for guided missiles and smooth-top cooking surfaces for stoves. They are suited to this wide range of applications because of extreme hardness, super strength, resistance to high heat, and transparency to radar. Stookey also pioneered photochromic glass, used to make optical lenses that darken and lighten in reaction to changes in light.

Born in Hay Springs, Nebraska, Stookey received his B.A. from Coe College, his M.S. from Lafayette College, and his Ph.D. from MIT. His career at Corning spanned over 45 years, until his retirement in 1987. His many awards include the 1994 National Medal of Technology.

Photo credit: Property of AT&T Archives, Reprinted with permission of AT&T

Arthur Leonard Schawlow

Masers and Maser Communications System

Patent No. 2,929,922

Born May 5, 1921
Died April 28, 1999

Inducted in 1996

Arthur L. Schawlow was co-inventor of the laser. He worked with Charles H. Townes, who was inducted into the National Inventors Hall of Fame in 1976. Schawlow was also a recipient of the Nobel Prize in physics. Schawlow was born in Mount Vernon, New York, and went on to attend the University of Toronto, graduating with a bachelor's degree in physics and mathematics in 1941. During the war, while teaching physics to military personnel, he earned his master's degree. In 1949, Schawlow received his Ph.D. in physics from the University of Toronto.

While doing postdoctoral research at Columbia University he met Charles Townes, and their long collaboration on microwave spectroscopy began. Schawlow and Townes sought ways to extend the maser principle of amplifying electromagnetic waves into the shorter wavelengths of infrared and visible light. They published a proposal for the laser in a 1958 issue of Physical Review and received a patent for it in 1960. By the end of the 1960s, eye surgeons were routinely using lasers. Today, the laser is prevalent in many areas, including the medical, defense, and communications fields.

In 1961, Schawlow became professor of physics at Stanford University. In 1981, Schawlow received the Nobel Prize in physics for his work in laser spectroscopy.

Photo credit: Courtesy of the National Institute of Standards and Technology

Jacob Rabinow

Reading Machine

Patent No. 2,933,246

Born January 8, 1910
Died September 11, 1999

Inducted in 2005

Jacob Rabinow invented machines that could recognize text, making it possible to automate vast amounts of routine work formerly done by hand.

A prolific inventor, Rabinow held more than 200 patents in fields ranging from optics and ordnance to clocks. His most significant achievements, however, involved his creation of a field known as OCR, or Optical Character Recognition. He invented a process that allowed machine scanners to determine which letters or numbers were printed on a page. Banks, the postal service, and numerous industries embraced his technology.

Rabinow's advanced techniques allowed machines to examine all kinds of text, regardless of font, and make a series of judgements that determined best matches with standard characters. Over the years he crafted a series of improvements that made the process more reliable, eventually incorporating dictionaries into computer memories so the machines could determine the identity of a smudged or messy character.

Rabinow, born in the Ukraine, immigrated to Brooklyn, New York in 1920. After studying electrical engineering at the City University of New York, he began his long career at the National Bureau of Standards where he developed OCR.

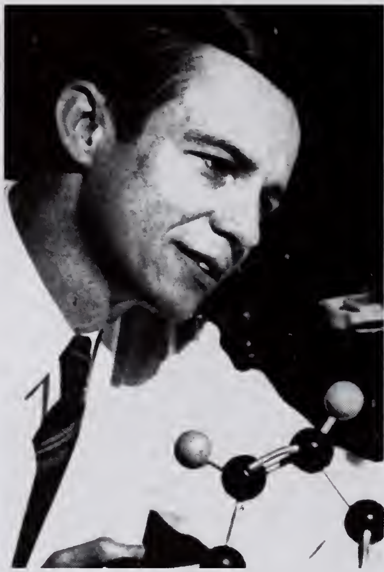

Photo credit: Joseph H. Burckhalter Collection

Joseph H. Burckhalter

Isothiocyanate Compounds and Means of Producing the Same

Patent No. 2,937,186

Born October 9, 1912
Died May 9, 2004

Inducted in 1995

Antibodies are the body's protectors. When antigens, like bacteria or viruses, enter the body, antibodies from a previous infection or vaccine deactivate the invaders. During the 1950s, as this was studied, it became a priority to identify antigens. Joseph Burckhalter and Robert Seiwald contributed to the identification of antigens through the synthesis of fluorescein isothiocyanate (FITC). The first practical and patented antibody labeling agent, the stable, yellow-green fluorescent compound has become widely used for rapid and accurate diagnosis of infectious diseases. FITC has played an important role in identifying the cause of AIDS and is used to distinguish between different strains of streptococci. FITC and red RITC (rhodamine isothiocyanate) are used together to diagnose leukemia and lymphoma.

Born in Columbia, South Carolina, Burckhalter earned a B.S. from the University of South Carolina in 1934, an M.S. from the University of Illinois, Urbana in 1938, and a Ph.D. from the University of Michigan in 1942. He then worked at Parke-Davis. From the pain-relieving drug Tylenol, he derived Camoquin, a cure for malaria. Burckhalter was a professor of medicinal chemistry at the University of Michigan from 1960 to 1983. After 1983, he spent time at the Florida Institute of Technology as a research professor.

Photo credit: Courtesy of Robert J. Seiwald

Robert J. Seiwald

Isothiocyanate Compounds and Means of Producing the Same

Patent No. 2,937,186

Born March 26, 1925

Inducted in 1995

Robert Seiwald and Joseph Burckhalter worked together to patent fluorescein isothiocyanate and rhodamine isothiocyanate, better known as FITC and RITC, at the University of Kansas in 1960. FITC was the first useful antibody labeling agent, and it is now used for quickly and efficiently identifying infectious diseases.

Prior to Seiwald and Burckhalter's work, the labeling idea for identifying diseases was introduced in 1941. It proved to be potentially useful but difficult to implement. Since its synthesis, FITC has proved infallible in diagnosing a great number of diseases. These include malaria, Legionnaire's disease, and differentiating between cancerous and noncancerous lesions of plasma cells. It also paved the way for the development of other labeling procedures, such as radioimmunoassay and enzyme-linked immosorbent assay (ELISA).

Born in Fort Morgan, Colorado, Seiwald served in World War II; he earned his B.S. in chemistry from the University of San Francisco and then his Ph.D. in organic chemistry from St. Louis University in 1954. Later that year he joined Burckhalter at the University of Kansas, where they worked on FITC and RITC. He was professor of organic chemistry at the University of San Francisco from 1957 until he retired in 1989.

Photo credit: Courtesy of Schenectady Museum

H. Tracy Hall

Synthetic Diamond

Patent No. 2,947,610

Born October 20, 1919
Died July 25, 2008

Inducted in 2010

The GE Research Laboratories announced on February 15, 1955 that H. Tracy Hall, along with Francis Bundy, Robert Wentorf, and Herbert Strong, had synthesized diamond from carbon in a process that was reproducible.

Scientists knew that graphite, a pure carbon substance, was needed to produce manmade diamonds. The GE researchers discovered that graphite was resistant to change due to strong bonding of the carbon atoms. By utilizing iron as a catalyst to free the carbon bonds and by applying high pressure and high temperature, they were able to turn graphite into manmade diamonds. The first successful reproducible experiment was completed on the morning of December 16, 1954 by Hall in his unique "Belt" apparatus.

Diamonds have a wide variety of applications because of their exceptional physical characteristics, including hardness and heat conductivity, making them ideal for use in cutting, grinding, and polishing. Today, over 100 tons or over 450 million carats of synthetic diamonds are produced annually for industrial use.

Originally from Ogden, Utah, Hall received his B.S., M.S., and Ph.D. degrees from the University of Utah. He worked at GE until 1955, then returned to Utah to become a professor and researcher at Brigham Young University. There he invented additional apparatus and products and founded several companies that manufacture diamonds and high-pressure equipment.

Photo credit: Courtesy of Schenectady Museum

Herbert M. Strong

Synthetic Diamond

Patent No. 2,947,610

Born September 30, 1908
Died January 30, 2002

Inducted in 2010

Herbert Strong, along with Tracy Hall, Francis Bundy, and Robert Wentorf, synthesized diamonds as part of Project Superpressure, as announced by the GE Research Laboratories in 1955. The group used high pressure, graphite, and a catalyst to achieve diamond chips suitable for industrial applications.

The four researchers knew that graphite, a pure carbon substance, was key to achieving manmade diamonds. They discovered, however, that graphite was resistant to change due to strong bonding of the carbon atoms. By utilizing iron sulfide as a catalyst to weaken the carbon bonds and by applying high pressure, they were able to turn the weakened graphite into manmade diamonds for the first time in December 1954.

Diamonds have a wide variety of applications because of their exceptional physical characteristics, including hardness and heat conductivity, making them ideal for use in cutting, grinding, and polishing. Today, over 100 tons or over 450 million carats of synthetic diamonds are produced annually for industrial use.

Strong joined the GE Research Lab in 1946 as a research associate. By the time of his retirement in 1973, he held 21 patents and had worked to synthesize carat-sized diamonds which found use in electronic equipment. He later worked with the Schenectady High School to develop a program called Fun with Physics to teach children about science.

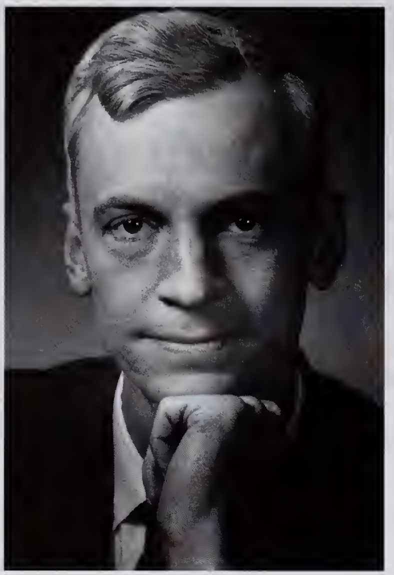

Photo credit: Courtesy of Schenectady Museum

Robert Wentorf, Jr.

Synthetic Diamond

Patent No. 2,947,610

Born May 28, 1926
Died April 3, 1997

Inducted in 2010

Robert Wentorf, along with Tracy Hall, Francis Bundy, and Herbert Strong, synthesized diamonds as part of Project Superpressure, as announced by the GE Research Laboratories in 1955. The group used high pressure, graphite, and a catalyst to achieve diamond chips suitable for industrial applications.

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Diamonds have a wide variety of applications because of their exceptional physical characteristics, including hardness and heat conductivity, making them ideal for use in cutting, grinding, and polishing. Today, over 100 tons or over 450 million carats of synthetic diamonds are produced annually for industrial use.

Born in West Bend, Wisconsin, Wentorf attended the University of Wisconsin where he received his B.S. and Ph.D. He spent his career at GE where he worked on additional innovations, including cubic boron nitride, which rivaled diamonds in hardness and had high heat resistance. After retiring from GE in 1988, he researched and taught at Rensselaer Polytechnic Institute.

Photo credit: Courtesy of Schenectady Museum

Francis P. Bundy

Diamond Synthesis

Patent No. 2,947,611

Born September 1, 1910
Died February 23, 2008

Inducted in 2010

Francis Bundy, along with Tracy Hall, Robert Wentorf, and Herbert Strong, synthesized diamonds as part of Project Superpressure, as announced by the GE Research Laboratories in 1955. The group used high pressure, graphite, and a catalyst to achieve diamond chips suitable for industrial applications.

The four researchers knew that graphite, a pure carbon substance, was key to achieving manmade diamonds. They discovered, however, that graphite was resistant to change due to strong bonding of the carbon atoms. By utilizing iron sulfide as a catalyst to weaken the carbon bonds and by applying high pressure, they were able to turn the weakened graphite into manmade diamonds for the first time in December 1954.

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Born in Columbus, Ohio, Bundy attended Otterbein College for his B.A. and Ohio State University for his Ph.D. He then taught at Ohio University before joining the Harvard Underwater Sound Lab during World War II. After the war effort, he joined GE. In 1987, he was the recipient of the Bridgman Gold Medal of the International Association for the Advancement of High Pressure Science and Technology.

Photo credit: AIP Emilio Segrè Visual Archives Physics Today Collection

Peter C. Goldmark

Phonograph Record

Patent No. 2,950,116

Born December 2, 1906
Died December 7, 1977

Inducted in 2007

Peter Goldmark invented the long-playing (LP) record that dominated the recorded music industry for forty years. As an engineer for CBS Laboratories, he also invented a system for transmitting and receiving color television and made numerous other innovations in electronics.

Born in Budapest, Hungary, Goldmark studied at the Universities of Berlin and Vienna before immigrating to the U.S. in 1933. After working as a consultant to various electronics companies, he joined CBS Labs. In 1948, Goldmark invented the LP by slowing the record from 78 revolutions per minute (rpm) to 33 1/3 rpm, increasing the length of the groove and decreasing its width. He made the LP of vinyl rather than shellac, and improved the phonograph's stylus and tone arm. His innovations made it possible to listen to entire symphonic movements and other long pieces without interruption, bringing the pleasure of long-playing recorded music to millions.

He also produced the first live color television images in 1940. His system was widely used in closed-circuit applications including surgical procedures, and it transmitted color pictures from the Apollo 15 mission back to Earth.

Goldmark earned 77 patents and was awarded the National Medal of Science in 1977.

Photo credit: Courtesy of Ampex Corporation

Charles P. Ginsburg

Broad Band Magnetic Tape Systems and Method

Patent No. 2,956,114

Born July 27, 1920
Died April 9, 1992

Inducted in 1990

Charles Ginsburg led the research team at Ampex Corporation in developing the first practical videotape recorder (VTR). The system used a rapidly rotating recording head to apply high-frequency signals onto a reel of magnetic tape. The VTR revolutionized television broadcasting.

Born in San Francisco, California, Ginsburg graduated with a B.A. from San Jose State in 1948 then worked as a studio and transmitter engineer at a radio station in the San Francisco Bay area. In 1952 he joined the Ampex Corporation. He held the position of vice president of Advance Development at Ampex from 1975 until his retirement in 1986. Tape recording of television signals dates to just after World War II, when audio tape recorders were pushed to record the very high frequency signals needed for television. These early machines ran the tape at very high speeds–240 inches per second–to achieve high-frequency response.

Ginsburg led the Ampex research team that developed a new machine that could run the tape at a much slower rate because the recording heads rotated at high speed, allowing the necessary high-frequency response. Recorded programs that could be edited replaced most live broadcasts. In 1956, CBS became the first network to employ VTR technology.

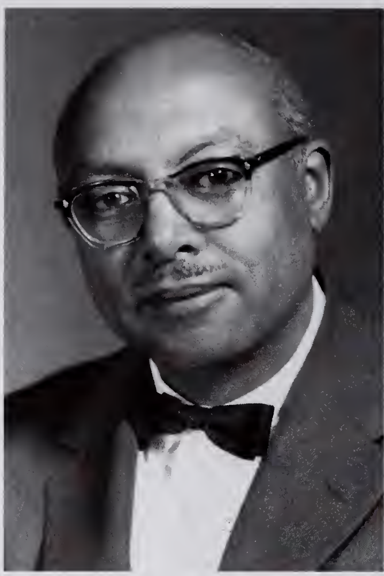

Photo credit: Provided by Phillip Hawkins

W. Lincoln Hawkins

Polymer Cable Sheath

Patent No. 2,967,845

Born March 21, 1911
Died August 20, 1992

Inducted in 2010

By finding a way to stabilize the polymers used to coat communications cable, Lincoln Hawkins and his Bell Labs colleagues Vincent Lanza and Field Winslow helped make universal telephone service possible. In addition, the work enriched scientists' understanding of the polyolefin stabilization process.

Until the 1940s, a lead-based coating was used to insulate telephone cables. The lead coating was expensive, and it was also too heavy to use in the multi-cable conduits needed to serve millions of people. Plastic coatings were tried, but quickly became brittle and would disintegrate when exposed to the elements. The team found a way to stabilize polyethylene and created a plastic cable insulation that could withstand changes in temperature and other environmental factors. The new coating greatly reduced the costs of building and maintaining modern telephone systems, and the use of lead, an environmental toxin, was eliminated.

Hawkins was also devoted to improving education and employment opportunities for minorities interested in pursuing careers in engineering and science, helping to establish the Bell Labs Summer Research Program for Minorities and Women. Born in Washington, D.C., Hawkins attended Rensselaer Polytechnic Institute and Howard University, and ultimately McGill University where he received his Ph.D. In 1942, he was the first African-American scientist hired by Bell Labs. In 1992, he was presented with the National Medal of Technology.

Photo credit: Courtesy of Drew Lanza

Vincent L. Lanza

Polymer Cable Sheath

Patent No. 2,967,845

Born March 26, 1922
Died June 18, 1972

Inducted in 2010

By finding a way to stabilize the polymers used to coat communications cable, Vincent Lanza and his Bell Labs colleagues Lincoln Hawkins and Field Winslow helped make universal telephone service possible. In addition, the work enriched scientists' understanding of the polyolefin stabilization process.

Until the 1940s, a lead-based coating was used to insulate telephone cables. The lead coating was expensive, and it was also too heavy to use in the multi-cable conduits needed to serve millions of people. Plastic coatings were tried, but quickly became brittle and would disintegrate when exposed to the elements. The team found a way to stabilize polyethylene and created a plastic cable insulation that could withstand changes in temperature and other environmental factors. The new coating greatly reduced the costs of building and maintaining modern telephone systems, and the use of lead, an environmental toxin, was eliminated.

Born in Greenwich Village, New York, Lanza studied at New York University where he received his B.S., M.S., and Ph.D. degrees in organic chemistry. He worked at Bell Labs until 1959, when he began work at Raychem Corporation. At the time of his death, he was Raychem's vice president of research and development and recognized as a pioneer in cross-linked polymer chemistry.

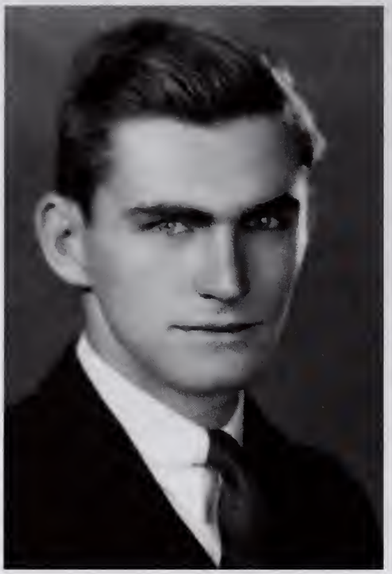

Photo credit: Courtesy of Field H. Winslow Family

Field Winslow

Polymer Cable Sheath

Patent No. 2,967,845

Born June 10, 1916
Died December 16, 2009

Inducted in 2010

By finding a way to stabilize the polymers used to coat communications cable, Field Winslow and his Bell Labs colleagues Lincoln Hawkins and Vincent Lanza helped make universal telephone service possible. In addition, the work enriched scientists' understanding of the polyolefin stabilization process.

Until the 1940s, a lead-based coating was used to insulate telephone cables. The lead coating was expensive, and it was also too heavy to use in the multi-cable conduits needed to serve millions of people. Plastic coatings were tried, but quickly became brittle and would disintegrate when exposed to the elements. The team found a way to stabilize polyethylene and created a plastic cable insulation that could withstand changes in temperature and other environmental factors. The new coating greatly reduced the costs of building and maintaining modern telephone systems, and the use of lead, an environmental toxin, was eliminated.

Winslow was born in West Rutland, Vermont and completed his undergraduate studies at Middlebury College. He received his Ph.D. from Cornell, and then worked on the Manhattan Project where he helped develop early fluoropolymers. He joined Bells Labs in 1945, becoming head of Polymer R&D and Organic Chemistry R&D. He was also seen as an expert in macromolecular science, serving as a founder of the American Chemical Society's *Macromolecules* publication.

Photo credit: Courtesy of Intel Corporation

Robert N. Noyce

Semiconductor Device-and-Lead Structure

Patent No. 2,981,877

Born December 12, 1927
Died June 3, 1990

Inducted in 1983

Robert N. Noyce, cofounder of Intel Corporation, was one of the pioneers of semiconductor development.

Born in Iowa, he received a B.A. from Grinnell College (Iowa) in 1949 and a Ph.D. in physical electronics from the Massachusetts Institute of Technology in 1953. He did research at Philco Corporation until 1956, when he joined Shockley Semiconductor Laboratory in Palo Alto, California, to work on transistor technology.

In 1957 Noyce cofounded the Fairchild Semiconductor Corporation in Mountain View, California. He was research director until early 1959 when he became vice president and general manager. As research director of Fairchild Semiconductor, he was responsible for initial development of the firm's silicon mesa and planar transistor product lines.

In July 1968 he cofounded Intel Corporation with Gordon E. Moore, who had also been a cofounder of Fairchild Semiconductor and a member of the Shockley laboratory staff. Noyce served as president of Intel until 1975 and chairman of the board from 1975 to 1979. Noyce held 16 patents for semiconductor devices, methods, and structures.

Photo credit: Courtesy of Devol Family

George Devol

Programmed Article Transfer

Patent No. 2,988,237

Born February 20, 1912

Inducted in 2011

In the 1930s, George Devol began realizing the value of factory automation while working on magnetic recording technology. In 1954, he filed a patent for a robotic arm that could move with six degrees of freedom and store step-by-step digital commands on a drum or other medium. This would become the Unimate industrial robot.

In 1956, Devol met Joseph Engelberger, and together they founded Unimation, Inc., the first robotics company. In 1961, the first Unimate was installed at a GM plant and carried out programmed commands to retrieve and stack hot die-cast metal pieces. Unimation soon began full scale production, expanding to include robots that could weld, print, and assemble. Unimation was sold in 1983 to Westinghouse, who later sold it to a French company.

Devol's patent for the first digitally operated programmable robotic arm represents the foundation of the modern robotics industry. Today, industrial robots have transformed factories into safer places and improved products with precision and consistency.

Devol has been a self-employed inventor since 1945, and he continues to run Devol Research. In 1989, he received an honorary doctorate from the University of Bridgeport. The original Unimate resides in the Smithsonian Institution's collections.

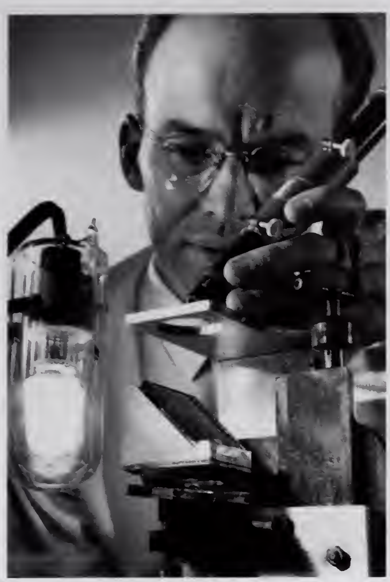

Photo credit: General Electric Research and Development

Robert N. Hall

Asymmetrically Conductive Device and Method of Making the Same

Patent No. 2,994,018

Born December 25, 1919

Inducted in 1994

Robert Hall invented the version of the magnetron that operates most microwave ovens, the semiconductor laser found in compact disc players, and power rectifiers that greatly improved power transmission efficiency. Born in New Haven, Connecticut, Hall earned a B.S. in Physics at CalTech in 1942 and a Ph.D. in physics at CalTech in 1948. He then returned to the General Electric Research and Development Center in Schenectady, New York, where he had worked during World War II on continuous wave magnetrons to jam enemy radar. These were later incorporated into microwave ovens.

After the war Hall worked first on transistors, succeeding in making ingots of never-before-available intrinsic germanium from which devices could be fabricated. A "chance observation" while measuring the electrical properties of one of these ingots led him to his discovery of alloyed p-n junctions, the fundamental elements of power rectifiers and some transistors. His basic rectifier structure, with silicon replacing the germanium, is used today for AC-to-DC power conversion in electric locomotives and high-voltage DC electrical transmission.

In 1962 Hall invented the semiconductor injection laser, a device now used in all compact disk players and laser printers, and most optical fiber communications systems.

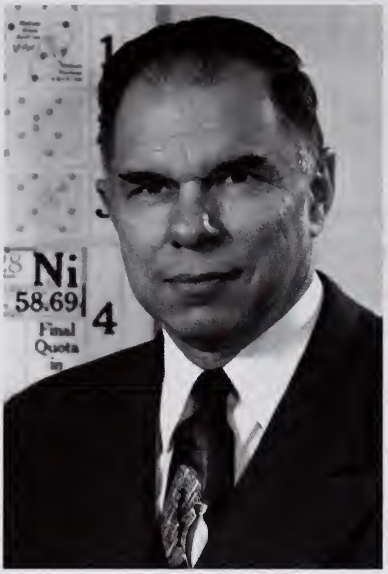

Photo credit: Lawrence Berkeley National Laboratory

Glenn T. Seaborg

Compounds and Compositions Containing Plutonium

Patent No. 3,000,695

Born April 19, 1912
Died February 25, 1999

Inducted in 2005

Glenn T. Seaborg was a central figure in the effort to develop atomic technology. The nuclear chemist's best-known achievement was the synthesis and isolation of the radioactive element plutonium.

Seaborg spent most of his career at the University of California in Berkeley, where he stayed on after completing graduate school. He primarily studied radioisotopes, the unstable, radioactive forms of elements. He pioneered the creation of new exotic isotopes and elements by bombarding materials with atomic particles in the university's cyclotron and other particle accelerators, many of which his research team helped design.

He was one of the most important participants in the Manhattan Project, which developed the atomic bomb during World War II. In addition to his work developing nuclear weapons, he was a pioneer in the development of nuclear medicine and nuclear power.

Seaborg was born in Ishpeming, Michigan. He discovered 10 elements and more than 100 radioisotopes and won the Nobel Prize for chemistry in 1951. He also held the distinction of being the only living person to have a new element, seaborgium, named after him. He was a key figure in the campaign for nuclear disarmament, an influential educational reformer, and the first scientist to head the Atomic Energy Commission.

Photo credit: William P. Murphy, Jr.

William P. Murphy, Jr.

Disposable Medical Trays

Patent No. 3,013,656

Born November 11, 1923

Inducted in 2008

William Murphy, Jr., M.D., is a pioneer in applying engineering to medicine. His many successful medical devices include disposable medical procedure trays, blood bags, physiologic cardiac pacemakers, angiographic injectors, and hollow fiber artificial kidneys.

Having partnered in developing plastic blood bags and as the result of observations made during the Korean War, Murphy created a compression system for sealed blood bags that allowed for efficient and safe pressure transfusions. Also realizing that reused medical instruments were often damaged in processing, he designed inexpensive medical procedural trays of drugs and sterilized instruments that could be discarded after one use. Today, they are used in hospitals worldwide.

In 1957, he founded Medical Development Corporation in his garage. Soon after, it became Cordis Corporation, which today, as a subsidiary of Johnson & Johnson, focuses on developing medical instrumentation. Murphy also founded Small Parts, Inc., now an Amazon company, which provides small and large quantities of specialized materials and tools to engineers.

Born in Boston, Murphy graduated from Harvard in 1946 in pre-medicine. He earned his M.D. from the University of Illinois in 1947 and studied engineering at MIT. An education advocate, Murphy helped establish FIRST (For Inspiration and Recognition of Science and Technology), a program for young people that was founded by NIHF inductee Dean Kamen.

Photo credit: Michael Ochs Archives.com

Les Paul

Electrical Musical Instruments

Patent No. 3,018,680

Born June 9, 1915
Died August 13, 2009

Inducted in 2005

Les Paul introduced the world to the solid-body electric guitar, a pioneering instrument that transformed popular music.

Born in Waukesha, Wisconsin, Les Paul became a professional musician as a teenager and was the leader of his own trio by the age of 21. From the beginning of his career, Paul was fascinated by the opportunities of amplifying musical instruments electronically. He tinkered with a wide range of techniques in search of a way to produce a pleasing and unique sound.

His innovations led to his first solid-body electric guitar in 1941. Coupled with his pioneering recording techniques, Paul introduced the public to his fast, multi-layered productions that frequently included Paul playing as many as six musical parts simultaneously through the process of overdubbing. He also designed and built his own multi-track tape recorders.

The quality and originality of Les Paul's work inspired a generation of musicians to embrace his guitar and recording techniques. In 1952, the Gibson Musical Instrument Co. began selling its popular Les Paul model electric guitar. It rapidly established the new instrument as a powerful influence in the entertainment industry.

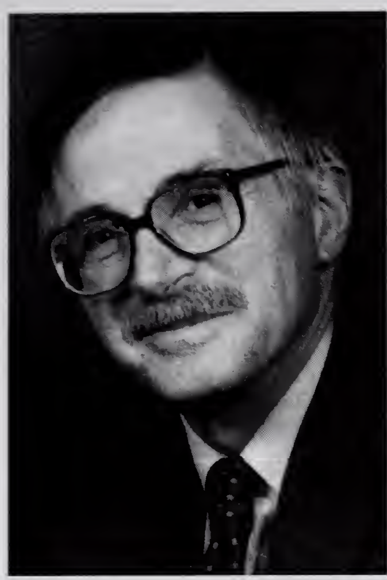

Photo credit: ©Carolyn Caddes

Jean A. Hoerni

Method of Manufacturing Semiconductor Devices

Patent No. 3,025,589

Born September 26, 1924
Died January 12, 1997

Inducted in 2009

Early in 1959 while at Fairchild Semiconductor, Jean Hoerni invented the planar manufacturing process, a method in which a silicon wafer is repeatedly coated with silicon oxide and precisely engraved so that the components of a transistor can be deposited in interconnected layers on the surface. This method solved the reliability issues that had plagued Fairchild Semiconductor's state-of-the-art "mesa" transistors, led to the development of Robert Noyce's integrated circuit, and is still relied upon for the manufacture of today's modern integrated circuits.

Hoerni, a native of Geneva, Switzerland, was among the eight men who left Shockley Semiconductor to found Fairchild Semiconductor. Hoerni left Fairchild in 1961 to found Teledyne's Amelco division. In 1963, he left to lead a Union Carbide research division. He founded the firm Intersil in 1967, and a later a firm called Telmos. He served as a consultant to semiconductor firms around the world.

Trained as a theoretical physicist, Hoerni held undergradute and Ph.D. degrees from the University of Geneva and another Ph.D. from Cambridge University. An avid high-altitude hiker, Hoerni created the Central Asia Institute to enable Greg Mortenson to build schools in remote areas of Pakistan and Afghanistan.

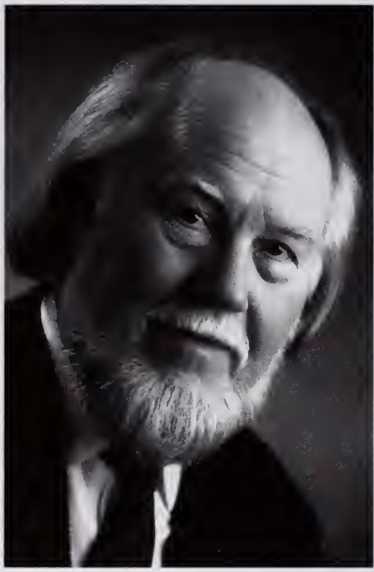

Photo credit: Courtesy of Nils Bohlin

Nils I. Bohlin

Safety Belt

Patent No. 3,043,625

Born July 17, 1920
Died September 21, 2002

Inducted in 2002

Nils Bohlin, while with Volvo, invented the three-point safety belt, a standard in the modern automobile. Early tests showed that the belt was effective in restraining the body in high-speed crashes and in preventing ejection. The National Highway Traffic Safety Administration estimates that in the U.S., the seat belt saves over four thousand lives and prevents over 100,000 injuries a year.

Bohlin was recruited in 1958 by Volvo to become its first safety engineer. Coming from the aerospace industry, Bohlin had seen stresses that the human body undergoes in high-speed crash situations, and he understood the limitations of restraint devices, particularly those that were uncomfortable and difficult to use. Following a year of extensive testing and engineering, Bohlin realized that straps across the chest and across the hips restrained people efficiently. His simple solution allowed a person to buckle up with just one hand. The seat belt proved so effective that Volvo sent Bohlin to America to promote his seat belt to the Consumer Products Safety Commission.

Bohlin's career in safety engineering covers both the aerospace and automotive industries. A native of Sweden, he is a member of the Automotive Hall of Fame and was a 1995 recipient of a Gold Medal from the Royal Swedish Academy of Engineering Sciences.

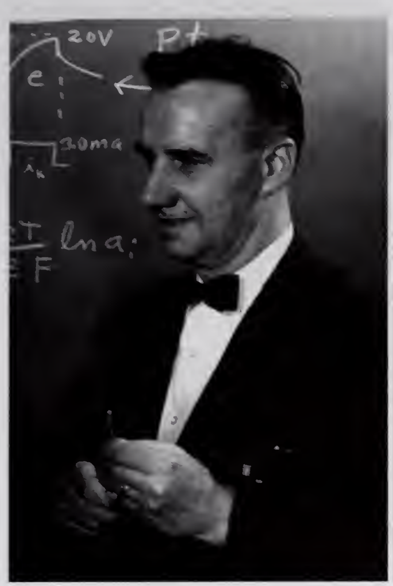

Photo credit: Courtesy of Wilson Greatbatch

Wilson Greatbatch

Medical Cardiac Pacemaker

Patent No. 3,057,356

Born September 6, 1919

Inducted in 1986

Wilson Greatbatch invented the cardiac pacemaker, an innovation selected in 1983 by the National Society of Professional Engineers as one of the two major engineering contributions to society during the previous 50 years. Born in Buffalo, New York, Greatbatch entered military service in 1936 and served in the Atlantic and Pacific theaters during World War II. He was honorably discharged as an aviation chief radioman in 1945. He attended Cornell University and graduated with a B.E.E. in 1950 and received a master's from the State University of New York at Buffalo in 1957.

Although trained as an electrical engineer, Greatbatch has primarily studied interdisciplinary areas combining engineering with medical electronics, agricultural genetics, the electrochemistry of pacemaker batteries, and the electrochemical polarization of physiological electrodes. His original pacemaker patent resulted in the first implantable cardiac pacemaker, which has led to heart patient survival rates comparable to that of a healthy population of similar age.

Greatbatch has established a series of companies to manufacture or license his inventions, including Greatbatch Enterprises, which produces most of the world's pacemaker batteries.


Photo credit: Courtesy of Cathy Bird Natoni

Forrest M. Bird

Fluid Control Device; Respirator; Pediatric Ventilator

Patent Nos. 3,068,856; 3,191,596; 3,842,828

Born June 9, 1921

Inducted in 1995

A little green box called "The Bird" became familiar to hospital patients throughout the world after it was introduced in 1958. It was the first highly reliable, low-cost, mass-produced medical respirator in the world, invented by Forrest Bird.

Bird was born in Stoughton, Massachusetts. His father, a World War I pilot, encouraged him to solo in an airplane by age 14. During World War II, as an officer with the Army Air Corps, Bird became a technical air training officer. At that time supercharged airplanes were beginning to exceed altitudes at which pilots could breathe unaided. This provided Bird his first chance at developing technology for aiding breathing.

After attending numerous medical schools and completing diverse residencies, Bird developed the prototype Bird Universal Medical Respirator for acute or chronic cardiopulmonary care. He tested the device by traveling to medical schools and asking doctors for their most ill patients. In each case known therapies had failed and the patient was expected to die of cardiopulmonary failure. Although some patients died, many times the Bird succeeded. In recognition of his work, Bird received the 2008 National Medal of Technology and Innovation.

The "Babybird" respirator, introduced in 1970, reduced infant mortality due to respirator problems from 70 percent to less than ten percent.

Photo credit: NEC Corporation

Dawon Kahng

Electric Field Controlled Semiconductor Device

Patent No. 3,102,230

Born May 4, 1931
Died May 13, 1992

Inducted in 2009

Dawon Kahng was an inventor of the first practical field-effect transistor, a device that controls electronic signals by switching them on or off or amplifying them. While the field-effect transistor had been theorized for many years, Kahng and his colleague Martin Atalla were the first to build a working version, making use of Atalla's new method of coating a silicon wafer with an insulating layer of silicon oxide so that electricity could reliably penetrate to the conducting silicon below – a process called surface passivation that became critical to the semiconductor industry.

Although Kahng and Atalla announced their device in 1960, it was not immediately embraced by their employer Bell Labs or by the semiconductor industry. Today, however, what is now known as the metal-oxide-semiconductor field-effect transistor, or MOSFET, is the most widely used type of integrated circuit in the computer and electronics industries.

Dawon Kahng was born in Seoul, South Korea. He received a bachelor's degree from Seoul National University in 1955. His master's and doctorate degrees are from Ohio State University. After graduation in 1959, Kahng joined Bell Telephone Laboratories, retiring in 1988. He then founded the NEC Research Institute, which conducts basic science research in computing and communications.

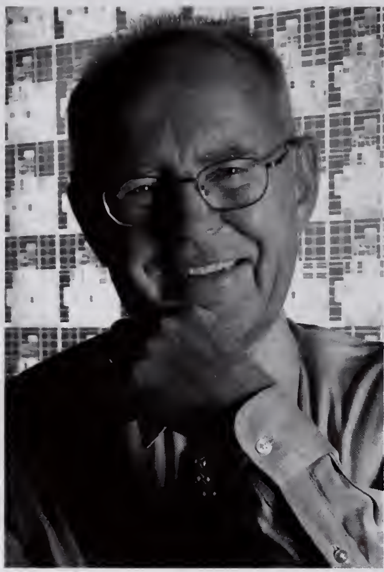

Photo credit: Intel

Gordon Moore

Method for Fabricating Transistors

Patent No. 3,108,359

Born January 3, 1929

Inducted in 2009

As a cofounder of both Fairchild Semiconductor and Intel, Gordon Moore set the pace and standards for Silicon Valley's chip manufacturing methods. Moore's work devising strategies that successfully transformed painstaking scientific experimentation into cost-effective products would establish the model of the computer industry researcher-entrepreneur and help make Intel a world-leading chip maker.

He is the author of Moore's Law, first given voice in 1965 and amended in 1975 to state that the number of transistors that can be mass-manufactured on an integrated circuit will double every two years.

Born in San Francisco, Moore received a Ph.D. from Caltech in 1954. He joined Shockley Semiconductor in 1956 but left with the "Fairchild Eight" in 1957 to form Fairchild Semiconductor, where he was director of research. In 1968, Moore became a cofounder of Intel, then president and CEO, then chairman until his retirement in 1997. Moore remains chairman emeritus of Intel and principal sponsor of the Gordon and Betty Moore Foundation, dedicated to global environmental conservation and scientific research, and quality of life in the San Francisco Bay Area. He is the recipient of many honors and awards, including the National Medal of Technology and the U.S. Medal of Freedom.

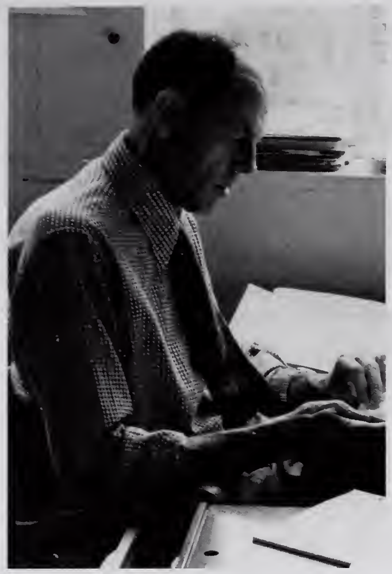

Photo credit: Courtesy of Gerhard Sessler

Gerhard M. Sessler

Electroacoustic Transducer

Patent No. 3,118,022

Born February 15, 1931

Inducted in 1999

Gerhard M. Sessler and James West invented the foil electret microphone while working at Bell Laboratories. This device, which was finalized in 1962, combines high performance features, such as broad frequency range, low noise, and high sensitivity with low cost. Its commercial production began in 1968. Today, almost two billion electret microphones are manufactured annually.

In the 1980s at the University of Darmstadt, Sessler developed the first condenser microphones based on silicon micromachining. This innovative technology allows for the fabrication of thousands of tiny microphones on a single silicon wafer. These can be used for hearing aids, hearing implants, and other applications.

Sessler was born in Rosenfeld, Germany and studied physics at the Universities of Freiburg, Munich, and Goettingen. After receiving his Ph.D. from Goettingen in 1959, Sessler moved to the United States to work at Bell Labs. He stayed at Bell Labs until 1975, when he returned to Germany to become professor of electroacoustics at the University of Darmstadt.

Sessler, who holds over 100 U.S. and foreign patents and is an IEEE Fellow, is the recipient of many awards, including the George R. Stibitz Trophy and the Helmholtz Medal, the highest award of the German Acoustical Society.

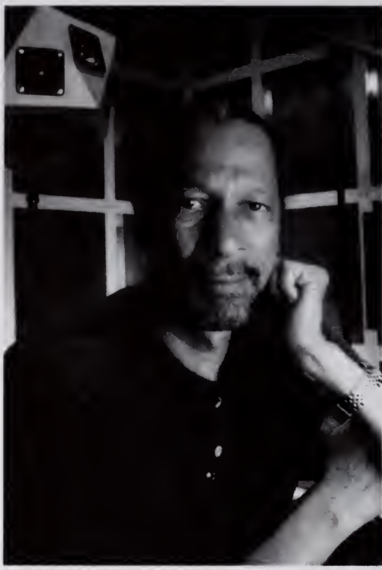

Photo credit: Courtesy of Bell Labs

James E. West

Electroacoustic Transducer

Patent No. 3,118,022

Born February 10, 1931

Inducted in 1999

In 1962, James West and Gerhard Sessler patented the electret microphone while working at Bell Laboratories. The microphone became widely used because of its high performance, accuracy, and reliability, in addition to its low cost, small size, and light weight.

In the electret microphone, thin sheets of polymer electret film are metal-coated on one side to form the membrane of the movable plate capacitor that converts sound to electrical signals with high fidelity. Ninety percent of today's microphones are electret microphones, and they are used in everyday items such as telephones, camcorders, and tape recorders.

West was born in Prince Edward County, Virginia. While attending Temple University, he interned at Bell Labs during his summer breaks and upon his graduation in 1957, he joined the company and began work in electroacoustics, physical acoustics, and architectural acoustics.

West, who is a Fellow of IEEE and a recipient of the George R. Stibitz Trophy, is the recipient of over 200 U.S. and foreign patents. He has also been honored with the 2006 National Medal of Technology. West is also an advocate for science education, particularly among minority students.

Photo credit: Courtesy of Harold A. Rosen

Harold A. Rosen

Apparatus Providing a Rotating Directive Antenna Field Pattern Associated With a Spinning Body

Patent No. 3,133,282

Born March 20, 1926

Inducted in 2003

Harold Rosen created the geosynchronous communications satellite. With an orbital period of 24 hours, it remains stationary in the sky and provides continuous communication without requiring a fleet of satellites or tracking user antennas. Such satellites are now a substantial factor in global communications, particularly for television.

Rosen was born in New Orleans where he attended Tulane University, then moved to California, earning his doctorate at the California Institute of Technology. He designed anti-aircraft missile guidance and control systems while at the Raytheon Company before joining the Hughes Aircraft Company. It was there that, in response to the Sputnik launch and compelling problems in international communications, he and his team designed the first practical communications satellite.

Not all of Rosen's work relates to satellites. He has also been involved in the development of a hybrid power train for automobiles and is currently working on a communication system based on a high altitude long duration remotely piloted air vehicle.

Rosen's accolades include the National Medal of Technology and the Charles Stark Draper Prize.

Photo credit: Courtesy of IBM Corporate Archives

Louis Stevens

Data Storage Machine

Patent No. 3,134,097

Born April 15, 1925
Died October 17, 2009

Inducted in 2008

Louis Stevens, working with William Goddard and John Lynott and a team of engineers, invented a unique magnetic disk storage device. Their disk drive, announced in 1955, was a key component of the IBM 305 RAMAC machine, and allowed users to store and almost instantly access large amounts of data.

Prior to the invention of the magnetic disk drive, data for computer processing technology was stored on punched cards, paper tapes, magnetic tapes, and magnetic drums. None could match the combination of storage density and rapid direct access provided by the magnetic disk drive.

The features of the original disk drive continue to be used in modern drives. Early in the 21st century, the industry was producing over 250 million drives annually and generating over $20 billion in sales worldwide.

Stevens was born in Post, Texas. He earned his BSEE from Texas Tech in 1948 and his MSEE from the University of California at Berkeley in 1949. After working briefly for IBM in Poughkeepsie, in 1952 he transferred to San Jose. Although Stevens spent the majority of his career in San Jose and retired from there in 1984, he also spent time working at IBM's world headquarters in New York.

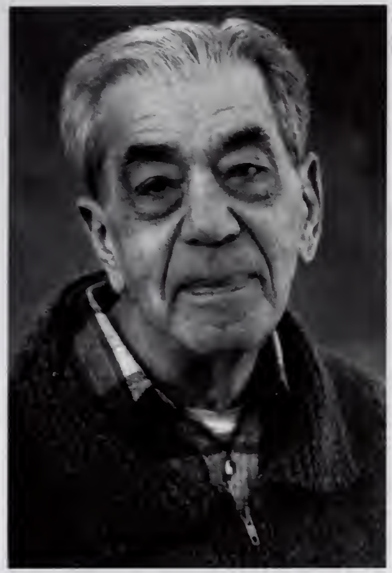

Photo credit: Courtesy of Arthur Nobile, Jr.

Arthur Nobile

Pregna-1, 4-Dienes and Compositions Containing Same

Patent No. 3,134,718

Born May 6, 1920
Died January 13, 2004

Inducted in 2007

Arthur Nobile's patent for the invention, medical use, and production of the steroids prednisone and prednisolone was one of the most significant advances in medicine during the mid-twentieth century. These highly effective anti-inflammatory drugs have saved many lives, alleviated much suffering, and have become indispensable in treating autoimmune diseases like rheumatoid arthritis, Addison's disease, and lupus.

Prior to Nobile's work, the steroid cortisone was the primary treatment for rheumatoid arthritis but had unpleasant side effects. In 1950, Nobile succeeded in using bacteria to oxidize cortisone to prednisone and hydrocortisone to prednisolone, yielding effective treatments with minimal negative reactions. Modifications of the prednisolone molecule have resulted in compounds to treat asthma, ulcerative colitis, cerebral edema caused by cancer, and skin disorders.

Born in Newark, New Jersey, Nobile studied at the University of Southern California before earning his A.B. from the University of California at Berkeley. The discovery of prednisone and prednisolone heralded a new area of chemical synthesis, creating a multibillion dollar industry based on the use of microbes to manufacture drugs.

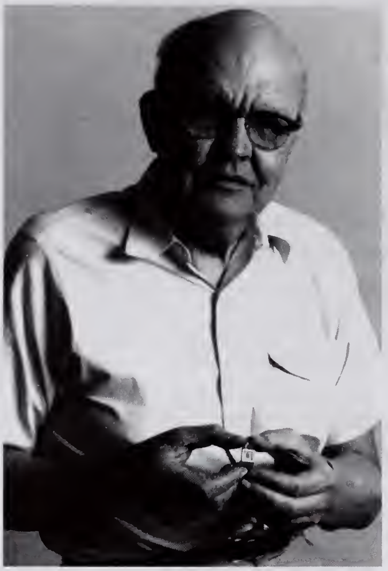

Photo credit: The Dallas Morning News/Lon Cooper

Jack S. Kilby

Miniaturized Electronic Circuits

Patent No. 3,138,743

Born November 8, 1923
Died June 20, 2005

Inducted in 1982

In 1959 electrical engineer Jack S. Kilby invented the monolithic integrated circuit, which is still widely used in electronic systems. Born in Jefferson City, Missouri, Kilby received a B.S.E.E. degree from the University of Illinois in 1947 and an M.S.E.E. from the University of Wisconsin in 1950.

From 1947 to 1958 he was responsible for the design and development of thick film integrated circuits at the Centralab Division of Globe Union Inc. in Milwaukee. In 1958 he joined Texas Instruments Inc. in Dallas where he was responsible for integrated circuit development and applications. Within a year he had invented the monolithic integrated circuit.

In 1970 Kilby took a leave of absence from the company to work as an individual inventor. Much of his work was directed toward the development of a novel solar energy system.

In 2000, he received the Nobel Prize in physics for his work with the integrated circuit.

Photo credit: Courtesy of Mobil Corporation

Charles J. Plank

Catalytic Cracking of Hydrocarbons with a Crystalline Zeolite Catalyst Composite

Patent No. 3,140,249

Born November 8, 1915
Died October 23, 1989

Inducted in 1979

Charles J. Plank and Edward Rosinski invented a zeolite catalyst commercially useful in the petroleum industry for the catalytic cracking of petroleum into lighter products such as gasoline. Today this catalyst, the first containing crystalline zeolite, is used in virtually all cracking units in the United States and in many other countries around the world. Catalysts have long been used in oil refining, but this one made a huge difference in the efficiency of the cracking process; it made possible a dramatic increase in gasoline yield from crude oil.

Born in Calcutta, India, Plank returned with his family to the United States while still a child and settled in his father's hometown of Lafayette, Indiana. In 1936 he received a B.S. in mathematics, chemistry, and physics from Purdue University. He later earned an M.S., and in 1942, he received his Ph.D. in physical chemistry from Purdue University.

Plank joined the research department of Socony-Vacuum Oil Company, the predecessor of Mobil Oil Corporation, in 1941. In 1970, he became senior scientist, the highest scientific post, at Mobil's Research and Development Laboratory in New Jersey. His career produced 83 U.S. patents and several hundred in other countries.

Photo credit: Edward Rosinksi Collection

Edward J. Rosinski

Catalytic Cracking of Hydrocarbons with a Crystalline Zeolite Catalyst Composite

Patent No. 3,140,249

Born August 12, 1921
Died May 4, 2000

Inducted in 1979

Edward J. Rosinski and Charles Plank produced a zeolite catalyst that increased the yield of gasoline by 40% from every barrel of oil run through a catalytic cracker. When heat is applied to petroleum, the larger molecules "crack" or break down to form simpler molecules like those found in gasoline. In 1961, it was discovered that certain crystalline zeolites could be combined into a binder and converted into a super-efficient cracking catalyst. Born in Gloucester County, New Jersey, Rosinski decided while still in high school to become a chemical engineer.

After graduating in 1939, he was employed by the Vacuum Oil Company as a petroleum engineer. In 1940, Rosinski enrolled at Drexel Institute of Technology, but his education was interrupted by a 1942-43 enlistment in the U.S. Army Air Force. After discharge from the army, he became an electronics test engineer at RCA and later at Atlas Instrument Company. In 1947, he returned to Socony-Vacuum as a lab technician, resumed his education, and in 1956 received a B.S. in Chemical Engineering at Drexel.

In 1972 he was promoted to senior research associate, the company's second-highest scientific post. Rosinski holds 76 U.S. patents, many in the field of zeolite catalytic technology.

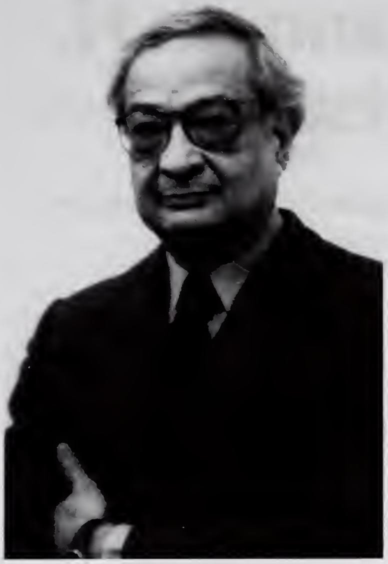

Photo credit: MIT News Service

Ali Javan

Gas Optical Maser

Patent No. 3,149,290

Born December 26, 1926

Inducted in 2006

Having made pioneering contributions to applied laser technology, Ali Javan's most significant invention is the helium-neon laser, the most useful and practical type of laser in use today.

Born in Tehran, Iran, Javan came to the U.S. in 1948 and earned his Ph.D. in physics from Columbia University in 1954. Javan continued his research at Bell Labs, where he conceived the gas laser principle, which led him to invent a laser composed of helium and neon.

The gas laser was the first continuous-light laser, which made its use in the telecommunications industry, specifically through fiber optics technology, invaluable. The impact of Javan's invention went beyond advancing telecommunications. It made holography practical, is used in UPC code checkout scanners, and is critical for a wide range of scientific, medical, and monitoring technologies.

Javan made several other important inventions and scientific breakthroughs. He developed the first absolutely accurate measurement of the speed of light and initiated the field of high-resolution laser spectroscopy at unprecedented accuracy. Revered by scientists for his advancements in laser technology, Javan was awarded the Albert Einstein World Medal of Science in 1993.

Photo credit: Courtesy of Digital Equipment Corporation, Corporate Photo Library

Kenneth H. Olsen

Magnetic Core Memory

Patent No. 3,161,861

Born February 20, 1926
Died February 6, 2011

Inducted in 1990

Kenneth H. Olsen, described by *Fortune* magazine in 1986 as the "most successful entrepreneur in the history of American business," invented vital computer components and cofounded Digital Equipment Corporation. Born in Stratford, Connecticut, Olsen began his career working summers in a machine shop. After serving in the Navy, he attended the Massachusetts Institute of Technology, earning a B.S. in 1950 and an M.A. in 1952. While at MIT, Olsen was recruited by the Air Force to help build a computerized flight simulator. He also directed the building of the first transistorized research computer.

In 1957, Olsen and Harlan Anderson formed the Digital Equipment Corporation. Digital began producing printed circuit logic modules used to test electronic equipment, and started developing the world's first small interactive computer. In 1960 Digital produced the Programmed Data Processor or PDP-1, a computer that used a cathode ray tube monitor. In 1965, Digital brought out the PDP-8, the world's first mass-produced minicomputer. In 1970 Digital produced the PDP-11, which became the most popular minicomputer line in history. In the 1960s, Olsen also received patents for a saturable switch, a diode transformer gate circuit, magnetic core memory, and the line printer buffer.

1965 to Present
Today's Inventive Climate

In the contemporary world of invention, computers have become both a major field of innovation and an indispensable tool for discovery in virtually every field. The computer has assisted in the move from microscopic to subatomic invention, including the manipulation of genes. It has also been a part of the surge in medical invention. In the past thirty years, non-invasive diagnostic technologies, advanced artificial organs, and more powerful electron microscopes have all become the tools of physicians. Computers, along with optical fibers and lasers that transmit data around the world, have helped advance telecommunications. As technology expands, the pressure to create new, marketable products grows. We cannot predict what effect today's inventions may have on tomorrow, but we can be certain the cycle of invention will continue.

Photo credit: Courtesy of Benjamin A. Rubin

Benjamin A. Rubin

Pronged Vaccinating and Testing Needle

Patent No. 3,194,237

Born September 27, 1917
Died March 8, 2010

Inducted in 1992

Microbiologist Benjamin A. Rubin ground the eyelet of a sewing machine needle into a fork shape to create a vaccine delivery system that helped wipe out the killer disease smallpox. Until relatively recently smallpox was a dreaded disease, killing at least two million people annually until 1967. Smallpox could be controlled by vaccination, but the vaccine was always in short supply and, in undeveloped areas of the world, it was difficult to conduct vaccinations.

Rubin was working for Wyeth Laboratories in 1965 when he began experimenting with alternatives to the conventional needle. Refinements to his design yielded the bifurcated (fork-shaped) needle, which he discovered would hold enough vaccine in the small space between the tines to inoculate a person with a few jabs. Rubin's needle sped vaccinations worldwide, and in 1980 the World Health Assembly declared smallpox defeated. For the first time, man eradicated a deadly disease.

Born in New York City, Rubin received his B.S. in biology-chemistry from the College of the City of New York, his M.S. in biology from Virginia Polytechnic Institute, and his Ph.D. in microbiology from Yale University. Before joining Wyeth Laboratories, Rubin worked for a number of laboratories and colleges. Later, he was a research professor of microbiology and public health at the Philadelphia College of Osteopathic Medicine.

Photo credit: Courtesy of the Atalla Family

Martin M. (John) Atalla

Semiconductor Devices Having Dielectric Coatings

Patent No. 3,206,670

Born August 4, 1924

Inducted in 2009

John Atalla is one of the inventors of the metal-oxide-semiconductor field-effect transistor (MOSFET), the most widely employed type of integrated circuit.

Born in Port Said, Egypt, Atalla came to the United States for graduate studies at Purdue University. After receiving his Ph.D. in 1949, he joined Bell Laboratories to investigate the surface properties of silicon semiconductors. By adopting a method of growing a layer of silicon dioxide on top of a silicon wafer, Atalla was able to overcome the surface states that prevented electricity from reaching the semiconducting layer. This is known as surface passivation, a critical step that made possible the ubiquity of silicon integrated circuits.

Atalla then suggested that a field effect transistor – first envisioned in the 1920s and confirmed experimentally in the 1940s but not yet achieved — be built of metal-oxide-silicon. Atalla assigned the task to Dawon Kahng, a scientist in his group. Atalla and Kahng announced their successful MOSFET at a 1960 conference.

In addition to Bell Labs, Atalla also worked for Hewlett-Packard and Fairchild Semiconducter. He later developed the data security system that is used in most automated banking machines. He has founded several companies, including Atalla Corp., A4 Systems, and TriStrata.

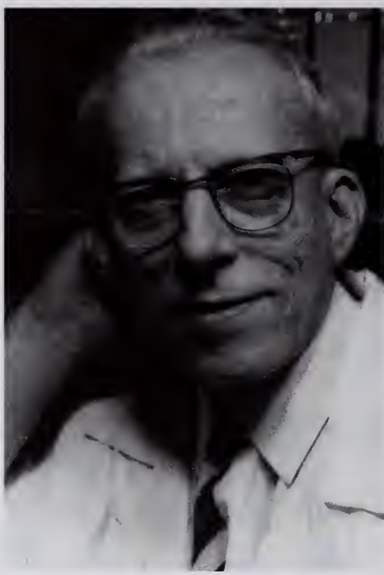

Photo credit: Archive of Institute of Chemical Technology in Prague

Otto Wichterle

Cross-Linked Hydrophilic Polymers and Articles Made Therefrom

Patent No. 3,220,960

Born October 18, 1913
Died August 8, 1998

Inducted in 2007

Working at his kitchen table, using an old phonograph and an Erector set, Otto Wichterle invented the soft contact lens and the process to manufacture it. In addition to being more comfortable than traditional glass or hard plastic lenses, Wichterle's lenses were less expensive, required a shorter adjustment period, and could be worn for longer periods of time.

Born in Prostjov, Moravia, Wichterle earned his Ph.D. from the Prague Institute of Chemical Technology (ICT). He worked as a professor at ICT in the 1950s creating a material suitable for eye implants known as hydroxy ethyl methacrylate, or HEMA, a polymer gel that absorbed water and was transparent.

Forced to leave ICT in a political purge, Wichterle continued his work on hydrogels at home with his wife, a doctor. In 1961, using his homemade device, he developed a spin-casting process that used centrifugal force to forge HEMA into soft, pliable lenses. Wichterle and his wife produced 5,500 lenses within five months. He made little money from his invention because the Czech government owned the rights to his process. The government sold those rights to an American optometrist for $330,000.

In 1966, Bausch and Lomb purchased the rights for $3 million. More than 100 million people improve their vision with contact lenses.

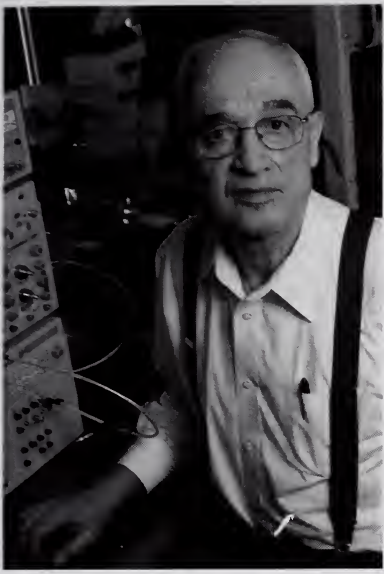

Photo Credit: L. Brian Stauffer

Nick Holonyak, Jr.

Use of Metallic Halide as a Carrier Gas in the Vapor Deposition of III-V Compounds

Patent No. 3,249,473

Born November 3, 1928

Inducted in 2008

Nick Holonyak invented the first visible light-emitting diodes (LEDs), today commonly found in applications ranging from traffic lights to consumer electronics.

Holonyak's research in optoelectronics has revolutionized the lighting, communications, and entertainment industries. His work is responsible for the technology used to develop red lasers in CD and DVD players, the ability to transmit information over the Internet, and applications in replacing conventional lighting with LEDs. Holonyak also created the basic electronic element of household light dimmer switches.

Born in Zeigler, Illinois, Holonyak attended the University of Illinois where he studied under his mentor NIHF Inductee John Bardeen who was a two-time Nobel Prize winner for inventing the transistor and explaining superconductivity. He received his Ph.D. in Electrical Engineering as Bardeen's first advanced student and went on to work for Bell Laboratories, serve in the military, and join the Advanced Semiconductor Laboratory of the General Electric Co. in 1957 where he made key contributions to the field of advanced semiconductor devices.

In 1963, Holonyak joined the University of Illinois faculty. Through his professional career, Holonyak has received numerous awards, and he is one of a handful of Americans to have been awarded both the National Medal of Science and the National Medal of Technology.

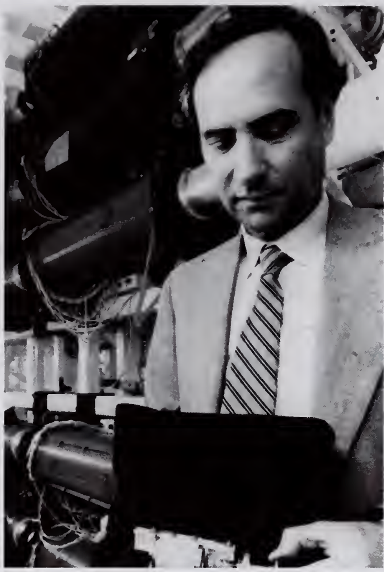

Photo credit: Courtesy of Theodore Maiman

Theodore Harold Maiman

Ruby Laser Systems

Patent No. 3,353,115

Born July 11, 1927
Died May 5, 2007

Inducted in 1984

Physicist Theodore Harold Maiman invented the first operable laser. Born in Los Angeles, California, Maiman in his teens earned college money by repairing electrical appliances and radios.

He attended the University of Colorado and received a B.S. in engineering physics in 1949. He then went on to do graduate work at Stanford University, where he received an M.S. in electrical engineering in 1951 and a Ph.D. in physics in 1955.

While employed at Hughes Research Laboratories as a section head in 1960, he developed, demonstrated, and patented a laser using a pink ruby medium, for which he gained worldwide recognition. In 1962 Maiman founded his own company, Korad Corporation, devoted to the research, development, and manufacture of lasers. He formed Maiman Associates in 1968 after selling Korad to Union Carbide Corporation.

He joined TRW in 1976 and has been responsible for directing the management of technology and the establishment of new high-technology ventures. He was a director of Control Laser Corporation and a member of the Advisory Board of Industrial Research Magazine.

Photo credit: Courtesy of Invent Now, Inc./Saemin Oh

Frank Wanlass

Low Stand-By Power Complementary Field Effect Circuit

Patent No. 3,356,858

Born May 17, 1933
Died September 9, 2010

Inducted in 2009

Frank Wanlass invented the complementary metal oxide semiconductor (CMOS), the technology employed in most modern microchips.

Wanlass joined Fairchild Semiconductor in 1962 from the University of Utah. Wanlass wanted to use Fairchild's planar manufacturing process to improve the stability of silicon field-effect transistors by joining p-channel and n-channel transistors. Wanlass had to overcome several technical hurdles, not the least of which was that the particular n-channel metal oxide field effect transistors that he needed did not yet exist. After some deft physics, Wanlass built his circuit.

In standby, Wanlass's demonstration CMOS drew six times less power than the day's state-of-the-art bipolar circuits. Because of their low power requirements, CMOS chips are well suited to battery-powered devices: the digital watch was one of the first products to make use of CMOS technology. The CMOS soon found wide application in the many other electronic products developed in the 1970s. CMOS chips are now part of nearly every electronic device, calculators and high-speed computers alike.

A native of Utah, Wanlass received a Ph.D. from the University of Utah. After leaving Fairchild in 1964, he was involved in several start-up ventures, including Four Phase, Zytrex, and Standard Microsystems.

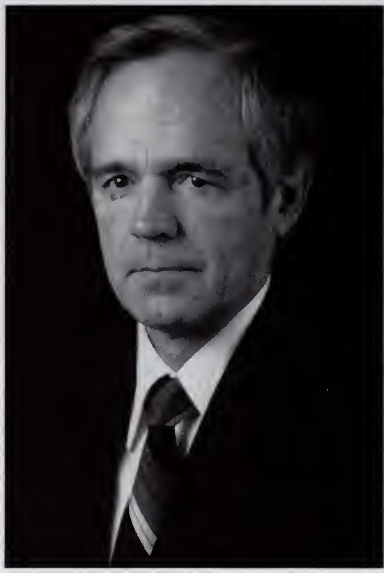

Photo Credit: Courtesy of Williams International

Sam B. Williams

Twin Spool Gas Turbine Engine With Axial and Centrifugal Compressors

Patent No. 3,357, 176

Born May 7, 1921
Died June 22, 2009

Inducted in 2003

Sam Williams, born in Seattle, Washington, became a pioneer toward the end of World War II by designing an early turboprop engine for the Navy and the first Chrysler automotive gas turbine; he holds patents on these engines. He started Williams International in 1954 to design, develop, and manufacture small gas turbine engines. His team developed the world's first small turbojet engine, which Williams International produced by the thousands for Navy targets.

In the 1960s his patented small turbofan engine got the attention of the Navy and Air Force when it provided the thrust for a vertical take-off and landing one-man flight system. Williams also produced this "world's smallest turbofan engine" by the thousands for Air Force and Navy cruise missiles.

Williams received the Collier Trophy and the Wright Brothers Memorial Trophy for making long-range cruise missiles feasible, which, as a deterrent, contributed to winding down the Cold War. He received the National Medal of Technology when his patented commercial turbofan engine made smaller, lower operating costs business jets feasible. These Williams' turbofan engines power three different Cessna Citations, the Raytheon Premier, the Sino-Swearingen SJ30 and Swedish Air Force Trainers. Sam Williams was awarded 73 patents.

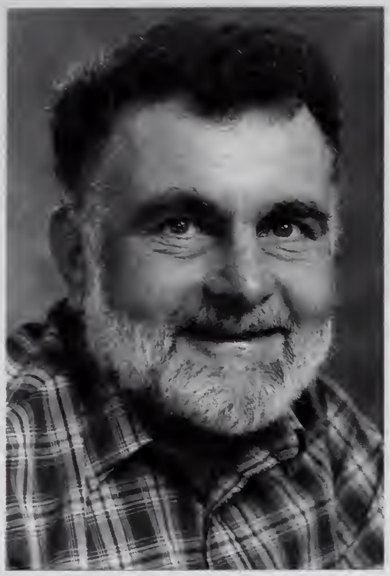

Photo credit: Courtesy of James Widlar

Robert Widlar

Biasing Scheme Especially Suited for Integrated Circuits

Patent No. 3,364,434

Born November 30, 1937
Died February 27, 1991

Inducted in 2009

Bob Widlar is considered the father of the analog monolithic integrated circuit. Called linear ICs, these tiny silicon chips process real-world signals like temperature and sound, unlike digital ICs that use ON/OFF signals. Since the time that Widlar invented the linear IC at Fairchild Semiconductor, the device has grown into a $37 billion business.

Widlar recognized that an IC could not be designed as a conventional circuit with discrete components. He developed a methodology using transistors to replace resistors, creating the first monolithic linear IC in 1963. Today, linear ICs are both widespread and affordable. Widlar also invented the Widlar current source and band gap voltage reference, still used today.

Born in Cleveland, Ohio, Widlar graduated from the University of Colorado in 1962 with a BSEE degree. Considered both genius and unpredictable, he joined Fairchild in 1963, then joined National Semiconductor in 1965. His work at National was so successful, he was able to retire in his early 30s to Puerto Vallarta. He was active in his retirement in Mexico, co-founding Linear Technology Corporation in 1981 and continuing as a consultant to National until his death in 1991.

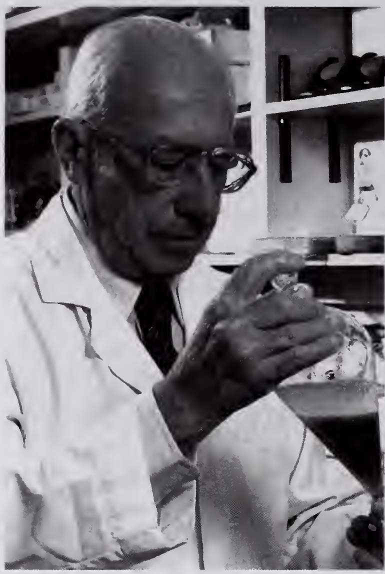

Photo Credit: Roche

Leo H. Sternbach

5-Aryl-3H-1, 4-Benzodiazepin-2(1H)-ones

Patent No. 3,371,085

Born May 7, 1908
Died September 28, 2005

Inducted in 2005

The discovery of benzodiazepines by Leo Sternbach and colleagues Lowell Randall and Earl Reeder improved many lives and introduced a new class of safe and effective tranquilizers to treat sleep and anxiety disorders. Librium® and Valium®, the first two drugs from a new class called benzodiazepines, proved to be more effective at reducing stress and anxiety than previous tranquilizers and had fewer side effects. The global healthcare company Roche introduced Librium® in 1960 and Valium® in 1963. Valium® was the most prescribed drug in the world from 1969 to 1982.

The success of Librium® and Valium® prompted further research into other types of benzodiazepines and several variants were developed by Roche (Versed®, Klonopin®, Dalmane®, and Lexotan®), in addition to products from other companies (Atavan® and Xanax®). Since their worldwide launch more than 40 years ago, benzodiazepines have proven to be safe and effective, when used properly.

Sternbach was born in Abbazia, now part of Croatia, and earned his Ph.D. in organic chemistry from the University of Krakow in Poland in 1931. He began work at Roche in 1940 in Switzerland but was forced to flee to the company's U.S. headquarters the following year to escape the Nazi occupation. Sternbach maintained an office at the Roche New Jersey site until 2004.

Photo credit: Courtesy of IBM

Robert H. Dennard

Field-Effect Transistor Memory

Patent No. 3,387,286

Born September 5, 1932

Inducted in 1997

Robert Heath Dennard invented one-transistor Dynamic Random Access Memory (DRAM), which allowed major increases in computer memory density and decreases in cost. It became the standard of the industry for RAM and enabled the microcomputer revolution. It is now commonly used in all forms of business and personal computers.

Born in Terrell, Texas, he received B.S. (1954) and M.S. (1956) degrees in Electrical Engineering from Southern Methodist University. In 1958 he received a Ph.D. in Electrical Engineering from Carnegie Institute of Technology and joined IBM's Research Division. Since 1963, he has been at IBM's Thomas J. Watson Research Center, where he has worked on field-effect transistors, integrated circuit design, and memory cells and organizations. Dennard received the patent for one-transistor DRAM in 1968.

Dennard has been a pioneer in scaling theory, which provides rules for making circuits smaller in every dimension. An IBM fellow since 1979, his awards include the National Medal of Technology, the Harvey Prize, from Technion (the Israel Institute of Technology), the IEEE Medal of Honor, and the Draper Prize.

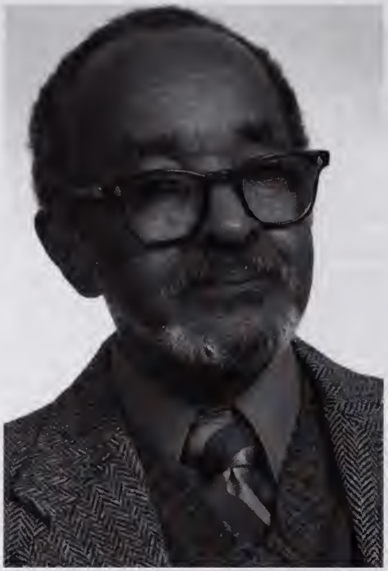

Photo credit: Courtesy of NASA

Emmett W. Chappelle

Lyophilized Reaction Mixtures

Patent No. 3,423,290

Born October 24, 1925

Inducted in 2007

Biochemist Emmett Chappelle discovered that a specific combination of chemicals caused all living organisms to emit light. Chappelle's discovery, known as bioluminescence, facilitated important findings within the fields of biology and chemistry.

Born in Phoenix, Arizona, Chappelle studied at the University of Washington, where he earned an M.A. in biology. In 1963, while working for NASA, Chappelle began exploring the qualities of light given off by different life forms. In charge of developing instruments used to scrape soil from Mars on NASA's Viking probe, Chappelle realized how chemicals gave off a measurable light when mixed with materials containing living cells. He applied this to detect bacteria in urine, blood, spinal fluids, drinking water, and foods.

Chappelle also advanced the development of laser-induced fluorescence as a means to detect plant stress. This technique allows scientists to determine the health of crops and measure their productivity based on the amount of light they emit. Using this information, farmers and crop specialists can adjust planting, irrigation, and fertilization patterns, greatly improving food production.

Throughout his career, Chappelle contributed to fostering the growth of technology, mentoring minority high school and college students.

Photo Credit: USDA/ARS

Ruth Benerito

Method For Producing Resilient Cotton Fabrics Through Partial Esterification

Patent No. 3,432,252

Born January 12, 1916

Inducted in 2008

Chemist Ruth Rogan Benerito is widely recognized for the development of wrinkle-free cotton.

Born in New Orleans, Benerito studied at Sophie Newcomb College, the women's college of Tulane University, earning a B.S. in chemistry in 1935. She received her M.S. from Tulane in 1938, and her Ph.D. from the University of Chicago in 1948. Early in her career, Benerito taught at Randolph-Macon Women's College and also at Tulane University. In 1953, she began work with the U. S. Department of Agriculture's Southern Regional Research Center where she remained for over 30 years.

At the USDA, Benerito's specialty was using cellulose chemistry to solve practical problems in the textile, wood, and paper industries. Her research showed that when specific reagents were bonded to cellulose, the cellulose fibers would not form creases. The result was a cotton fabric with wrinkle-resistance, and further research yielded many improvements to her initial discoveries.

Benerito also developed an intravenous fat emulsion that could be used for intravenous feeding, contributing to the care of long-term medical patients. Throughout her career, she has received over 55 patents and many honors, including the Garvan Medal from the American Chemical Society and the Lemelson-MIT Lifetime Achievement Award.

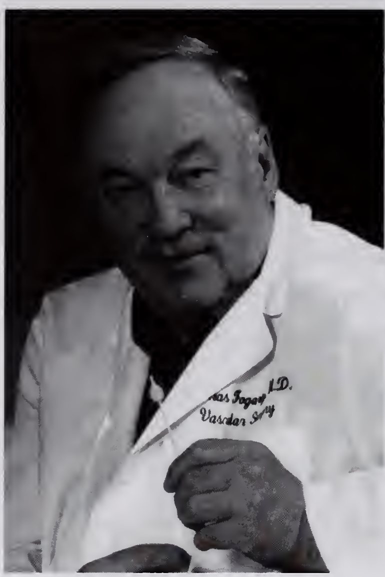

Photo credit: © Andrew Michaels Studio

Thomas J. Fogarty

Embolectomy Catheter

Patent No. 3,435,826

Born February 25, 1934

Inducted in 2001

In 1963, Thomas Fogarty received a patent for his Fogarty® balloon embolectomy catheter, which has since become an industry standard. The device allows a thin balloon to be inserted into a patient's artery and guided through an occlusion. It is then inflated and withdrawn along with the blockage. Fogarty's catheter revolutionized vascular surgery—it is still the most widely used technique for blood clot removal—and encouraged advances for other minimally invasive surgeries, including angioplasty.

Working with biomedical design engineers at Fogarty Engineering, Fogarty has developed many balloon devices that are used in laparoscopy-assisted surgical procedures. Other products include a minimally invasive device for breast cancer diagnosis and therapy and a self-expanding stent-graft used to treat aortic aneurysms less invasively to reduce trauma. A native of Cincinnati, Fogarty attended Xavier University and then went on to the University of Cincinnati College of Medicine.

Currently the president of Fogarty Engineering, Fogarty also spent time as a venture capitalist, funding start-up medical companies through his Three Arch Partners. In 1981, he founded the Thomas Fogarty Winery, located near San Francisco. Fogarty holds over 70 patents and has won numerous awards, including the Laufman-Greatbatch Prize for advances in medical instrumentation.

Photo Credit: Courtesy of NASA

Frank J. Cepollina

Strain Gauge Measuring Techniques

Patent No. 3,460,378

Born December 6, 1936

Inducted in 2003

The success of the Hubble Space Telescope is due to NASA's ability to repair and upgrade Earth-orbiting spacecraft via the space shuttle. Since its first historic repair mission in 1993, Hubble has delivered an unprecedented number of major discoveries. Frank J. Cepollina's work in the early 1970s made this possible, designing and developing the concept of modular spacecraft that could be serviced on-orbit by astronauts.

In 1984, Cepollina proposed and led the first on-orbit servicing project, the Solar Maximum Repair Mission. This demonstrated the feasibility of on-orbit spacecraft repair, replacement, and upgrading.

Subsequently, Cepollina's NASA team successfully serviced and upgraded Hubble in 1997, 1999, and 2002, leaving Hubble with far more power and capability. The techniques and training philosophy Cepollina and his team developed have become the mainstay in the assembly of the International Space Station.

His foresight has had far-reaching implications for NASA programs, including the space shuttle robotics arm and the space station power tools. Furthermore, the technology developed for the Hubble servicing missions has rippled into commercial applications in mammography, microchip manufacturing, and vibration-free, cryogenic cooling systems.

Photo credit: Courtesy of Robert W. Bower

Robert W. Bower

Field-Effect Device with Insulated Gate

Patent No. 3,472,712

Born June 12, 1936

Inducted in 1997

Robert Bower invented the Field-Effect Device with Insulated Gate known as the Self-Aligned Gate MOSFET, which has created the fast, design-stable device that is the foundation of all modern integrated circuits. Born in Santa Monica, California, Bower joined the Air Force in 1954. He attended UC Berkeley after his service, and in 1962 earned an A.B. in Physics while working at the Lawrence Radiation Laboratory.

His work led to a Hughes Fellowship and entry to the California Institute of Technology, where in 1963 he earned an M.S. in Electrical Engineering. In 1965 he joined Hughes Research, where he conceived ways of using ion engine technology in the semiconductor field. While at Hughes, he developed the concept of the Self-Aligned Gate Transistor using ion implantation to form the Source and Drain with the gate element as the self-aligned mask.

He returned to Cal Tech to work on his Ph.D. in Applied Physics in 1973. He was a founder of Mnemonics, a company developing his invention of high density CCDs (charge-coupled devices) for memory applications in 1975. In 1979 he joined Advanced Micro Devices as a senior scientist and in 1986, he became an IEEE Fellow. Recently, he has pioneered work on three-dimensional microelectronics.

Photo Credit: Courtesy of NASA

George R. Carruthers

Image Converter for Detecting Electromagnetic Radiation Especially in Short Wave Lengths

Patent No. 3,478,216

Born October 1, 1939

Inducted in 2003

George Carruthers invented the Far Ultraviolet Electrographic Camera. This camera uses ultraviolet light to study Earth's upper atmosphere, stars, and gases in interstellar space. It was first used in sounding rocket flights to study stars in 1966 and made the first discovery of molecular hydrogen in space in a 1970 flight.

This instrument is best known for its use in the Apollo 16 mission to the Moon in 1972, examining both Earth's far outer atmosphere and deep space from a location offering a global view of Earth. Over 200 pictures and spectra were taken from the Apollo mission, providing the first global images and spectra of Earth's far outer atmosphere, and images of stars, galaxies, and interstellar gas from a unique perspective.

Born in Cincinnati in 1939 and graduating from the University of Illinois with his Ph.D. in 1964, Carruthers has been deeply involved in both the engineering and science of space astronomy, studying the Earth's upper atmosphere.

Instruments he designed and developed were used in numerous other space flight missions, including Skylab, four space shuttle flights, and most recently, the Department of Defense's ARGOS unmanned satellite mission.

Photo credit: Louis Fabian Bachrach©

George Heilmeier

Electro-Optic Liquid Crystal Device

Patent No. 3,499,112

Born May 22, 1936

Inducted in 2009

George Heilmeier discovered four new electro-optic effects in liquid crystals in the 1960s and pioneered the first liquid crystal displays (LCDs) before continuing with a diverse career.

As a Ph.D. student, Heilmeier worked part-time at RCA Laboratories. Becoming interested in organic semiconductors, he focused his thesis on the field, and then researched electro-optic effects in liquid crystals, leading to the first LCDs. RCA was slow to market the new technology, but several Asian firms embraced it to develop today's booming market in flat screen displays.

After heading an RCA Laboratories research division, Heilmeier was a White House Fellow and a Special Assistant to the Secretary of Defense. He soon was Assistant Director of Defense Research and Engineering for Electronics and Computer Science, then Director of the Defense Advanced Research Projects Agency (DARPA). At DARPA, Heilmeier contributed to the first stealth aircraft and other major military initiatives. He rejoined industry as the Senior Vice President and Chief Technical Officer of Texas Instruments, and later, he became Chairman and CEO of Bellcore Corp., a billion dollar network software and design company, retiring in 1997.

A Philadelphia native, Heilmeier earned a bachelor's degree with honors in electrical engineering from the University of Pennsylvania and two master's degrees and a Ph.D. from Princeton.

Photo credit: Courtesy of IBM Corporate Archives

John Joseph Lynott

Direct Access Magnetic Disc Storage Device

Patent No. 3,503,060

Born August 25, 1921
Died April 20, 1994

Inducted in 2007

John Lynott and William Goddard, together with Louis Stevens and a team of engineers, invented a unique magnetic disk storage device at the IBM Lab in San Jose in the 1950s. The magnetic disk drive replaced data stored on punch cards and magnetic tape with almost instant, direct access storage and retrieval.

The magnetic disk drive consisted of a stack of closely spaced, magnetically-coated disks mounted on a rotating shaft, with read-write heads which did not physically touch the storage surface. Lynott and Goddard's key contribution was the air-bearing head, which "floated" very close to the rotating disks without actually touching, greatly increasing the speed of access. The invention validated IBM lab director Reynold Johnson's vision that disk storage could be made practical, provided quick, efficient access to large amounts of data, and ushered in a new era of interactive computer applications, such as airline reservation systems and personal computing. Today's magnetic disks are dramatically smaller and faster than the original, but many key features of Lynott and Goddard's team's design are still found in modern disk drives.

Born in Johnson City, New York, Lynott attended Syracuse University. He earned 25 patents for his work in mass-data storage during his 27-year career at IBM.

Photo credit: Courtesy of IBM Corporate Archives

William A. Goddard

Direct Access Magnetic Disc Storage Device

Patent No. 3,503,060

Born July 10, 1913
Died September 29, 1997

Inducted in 2007

William Goddard and John Lynott, together with Louis Stevens and a team of engineers, invented a unique magnetic disk storage device at the IBM Lab in San Jose in the 1950s. Able to store five million characters of information and retrieve any record in less than one second, the magnetic disk drive represented a technological leap forward in rapid access to mass data storage.

The magnetic disk drive consisted of a stack of closely spaced, magnetically-coated disks mounted on a rotating shaft, with read-write heads which did not physically touch the storage surface. Goddard and Lynott's key contribution was the air-bearing head, which "floated" very close to the rotating disks without actually touching, greatly increasing the speed of access.

The invention validated IBM lab director Reynold Johnson's vision that disk storage could be made practical, marked a revolution in computer architecture, performance, and applications, and gave birth to a new industry. By 2004, disk drive sales were approximately $22 billion worldwide.

Goddard was born in St. Joseph, Missouri. After earning his degree from Occidental College, he spent time working for North American Aviation, Inc. before establishing his career at the IBM Corporation.

Photo credit: Courtesy of The Bootstrap Institute

Douglas Englebart

X-Y Position Indicator for a Display System

Patent No. 3,541,541

Born January 30, 1925

Inducted in 1998

Douglas Engelbart's patent for the mouse is only a representation of his pioneering work designing modern interactive computer environments. Engelbart was born and grew up near Portland, Oregon. He served in the Navy as an electronics technician during World War II, and received his B.S. from Oregon State University. After working for NASA's Ames Research Laboratory, he received a Ph.D. from the University of California at Berkeley. He then joined the Stanford Research Institute (SRI), earning a number of patents related to computer components.

A main concern for Engelbart was how the computer could be used as a useful tool in tomorrow's office. While at SRI, he developed a hypermedia groupware system called NLS (oN-Line System). NLS utilized two-dimensional computerized text editing, and the mouse, used to position a pointer into text, was a critical component. During a 1968 demonstration, Engelbart first introduced NLS—this was the world debut of the mouse, hypermedia, and on-screen video teleconferencing. His project became the second host on Arpanet, the predecessor of the Internet.

In the 1970s and 1980s, Engelbart was a Senior Scientist at Tymshare, Inc., later acquired by McDonnell-Douglas. In 1989, he founded The Bootstrap Institute, which promotes the development of collective IQ through worldwide computer networks.

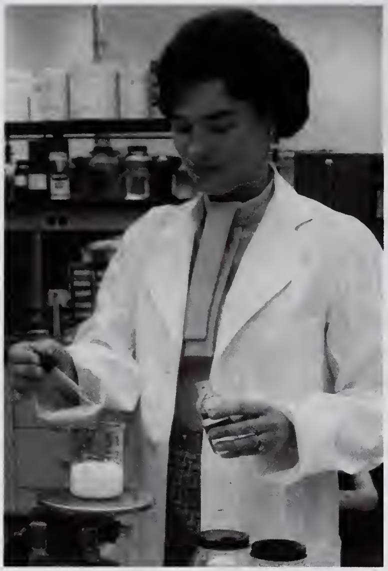

Photo credit: 3M

Patsy O. Sherman

Block and Graft Copolymers Containing Water-Solvatable Polar Groups and Fluoroaliphatic Groups

Patent No. 3,574,791

Born September 15, 1930
Died February 11, 2008

Inducted in 2001

Chemist Patsy Sherman and colleague Sam Smith were working at 3M Company when they created Scotchgard™. Scotchgard went on to become one of the most widely used and valuable products in stain repellency and soil removal, eventually bringing in over $300 million annually for 3M.

Sherman and Smith teamed up to develop the line of Scotchgard products after an accidental spill of a fluorochemical rubber intended for jet fuel hoses showed resistance to water and oily liquids. After the introduction in 1956 of a stain repellent treatment for wool, they later developed products designed for clothing, household linens, upholstery, and carpeting. Their research culminated in the late 1960s when they developed a product that both repelled stains and also permitted the removal of oily soils from synthetic fabrics, including the newly popular permanent press fabrics. Sherman and Smith jointly hold 13 patents in fluorochemical polymers and polymerization processes.

Born in Minneapolis, Sherman attended Gustavus Adolphus College in Minnesota. Upon graduating in 1952 with degrees in chemistry and mathematics, she joined 3M and remained there until her retirement in 1992. She has previously been inducted into the Minnesota Inventors Hall of Fame and is a Distinguished Alumna of her college.

Photo credit: 3M

Samuel Smith

Block and Graft Copolymers Containing Water-Solvatable Polar Groups and Fluoroaliphatic Groups

Patent No. 3,574,791

Born September 13, 1927
Died January 6, 2005

Inducted in 2001

Samuel Smith and Patsy Sherman collaborated from 1954 to 1972 in the chemical research that resulted in the birth and growth of 3M's family of Scotchgard™ textile protector finishes. These materials were fluorine-containing polymers that made textiles repellent to water and oil-borne stains. Additionally, carpet-treating formulations were developed to combine stain repellency with improved resistance to soiling by foot traffic.

By 1967, permanent press fabrics had become popular for many uses. These fabrics became notorious for their retention of oily stains, even through multiple cleanings. Smith and Sherman thought that a polymer in which water-loving segments were joined to specific water-repelling segments based on fluorochemicals might offer a solution to this problem. They then devised the intricate chemistry that allowed these different segments to be joined together. Permanent press treated with these products resulted in perfect oily stain release in a single wash.

Born in New York City, Smith received a B.S. from City College of New York in 1948 and an M.S. from the University of Michigan in 1949. He joined 3M in 1951 and retired as a Corporate Scientist in 1992. He held 30 U.S. patents and in 1988 won the American Chemical Society's Award for Creative Invention.

Photo credit: Courtesy of Charles D. Kelman

Charles D. Kelman

Material Removal Apparatus and Method Employing High Frequency Vibrations

Patent No. 3,589,363

Born May 23, 1930
Died June 1, 2004

Inducted in 2004

Dr. Charles Kelman is widely acknowledged as the leading innovator in the field of ophthalmology. His most celebrated achievement was the development of the procedure for removing cataracts known as phaco-emulsification, as well as the creation of instruments for carrying it out. In 1963, Kelman designed the phacoemulsifier, an instrument that liquifies cataracts within their capsules for extraction. Once the cataract is liquefied with a vibrating ultrasonic tip, the resulting fragments are then suctioned out through a small vibrating needle. This pioneering procedure dramatically reduced the risk of complications and turned a 10-day hospital stay into an outpatient procedure.

Kelman, born in Brooklyn, New York, received a B.S. from Tufts University in 1950 and completed his medical studies at the University of Geneva, Switzerland in 1956. The holder of over 100 patents, Kelman was the recipient of numerous awards, including the American Academy of Achievement Award (1970), the Ridley Medal from the International Congress of Ophthalmology (1990), the "Inventor of the Year Award" from The New York Patent, Trademark and Copyright Law Association (1992), and the prestigious National Medal of Technology (1992). In 1994, at the International Congress on Cataract and Refractive Surgery in Montreal, Kelman was named "Ophthalmologist of the Century" for his pioneering work in phacoemulsification.

Photo credit: Reprinted with permission of Alcatel-Lucent

Erna Schneider Hoover

Computerized Telephone Switching

Patent No. 3,623,007

Born June 19, 1926

Inducted in 2008

Erna Hoover, born in Irvington, New Jersey, made key contributions to the system architecture of the first electronic telephone central office developed by Bell Labs. This architecture used "stored program control" to achieve an unprecedented level of flexibility.

Hoover was awarded one of the first patents issued for software. It gave priority to processes concerned with the input and output of the switch over processes that were less important such as record keeping and billing. This provided more robust service to callers during peak calling times. Some of her work was done while she was recuperating from the birth of her second daughter in the hospital and at home.

Hoover received a B.A. from Wellesley College in classical and medieval philosophy and history in 1948 and a Ph.D. from Yale University in philosophy and foundations of mathematics in 1951. She was a professor in Swarthmore College from 1951 to 1954, when she joined Bell Labs. Later, she worked on the development of the Safeguard Anti-Ballistic Missile System and subsequently became the first woman to head a technical department.

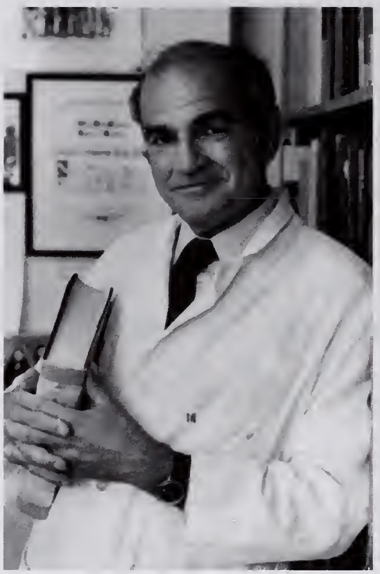

Photo credit: Fox Chase Cancer Center, Philadelphia, PA

Baruch S. Blumberg

Vaccine Against Viral Hepatitis and Process; Process of Viral Diagnosis and Reagent

Patent Nos. 3,636,191; 3,872,225

Born July 28, 1925
Died April 5, 2011

Inducted in 1993

Baruch Blumberg discovered an antigen in 1963 that detected the presence of hepatitis B in blood samples. Hepatitis B is a potentially fatal disease often transmitted through blood transfusions. This hepatitis antigen, "the Australia Antigen," was found frequently in the blood serum of viral hepatitis sufferers. The antigen was named for an aborigine blood sample that reacted with an antibody in the serum of an American hemophilia patient.

Together Blumberg and Irving Millman developed a vaccine against the virus. Since hepatitis B is an unknown factor associated with the development of liver cancer, the vaccine was the first against a major form of cancer.

Born in New York City, Blumberg graduated from Far Rockaway High School, then joined the Navy, which assigned him to study physics at Union College in Schenectady, New York (B.S., 1946). He has an M.D., 1951, from Columbia University, and a Ph.D. in biochemistry, 1957, from Balliol College at Oxford University.

He worked at the National Institutes of Health from 1957 to 1964 then joined Fox Chase Cancer Center and was also appointed professor of medicine and anthropology at the University of Pennsylvania. Blumberg shared the Nobel Prize in Medicine and Physiology in 1976.

Photo credit: Personal Collection of Dr. Irving Millman

Irving Millman

Vaccine Against Viral Hepatitis and Process; Process of Viral Diagnosis and Reagent

Patent Nos. 3,636,191; 3,872,225

Born May 23, 1923

Inducted in 1993

Microbiologist Irving Millman, working with Baruch Blumberg, developed a test that identified hepatitis B in blood samples. The blood test screened carriers of this disease, and after blood banks began using the test in 1971, hepatitis B after blood transfusions decreased by 25 percent. The test also became the first method for screening blood donations for the hepatitis B virus. Blumberg and Millman collaborated to create a vaccine for the virus. This vaccine protects people exposed to hepatitis B and has been administered to millions.

Irving Millman was born in New York City. He received a B.S. in 1948 from City College in New York, an M.S. in 1951 from the University of Kentucky, and a Ph.D. in 1954 from the Northwestern University Medical School. He joined Fox Chase Cancer Center in 1967.

Millman has served as adjunct professor of biology at Hahnemann University in Philadelphia. He has been a member of the New York Academy of Sciences, the American Association for the Advancement of Science, and the American Society of Microbiology; additionally, he is a fellow of the American Academy of Microbiology.

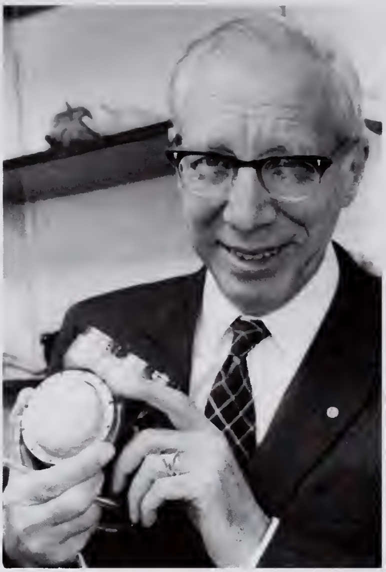

Photo credit: Courtesy of Willem J. Kolff

Willem J. Kolff

Soft Shell Mushroom Shaped Heart

Patent No. 3,641,591

Born February 14, 1911
Died February 11, 2009

Inducted in 1985

Medical researcher Willem J. Kolff invented the soft shell mushroom shaped heart and the artificial kidney dialysis machine. Born in the Netherlands, Kolff received his M.D. in Leiden in 1938 and a Ph.D. degree from the University of Groningen in Holland in 1946. He held nine honorary doctorates.

From 1934 Kolff held numerous medical research positions in the Netherlands and the United States. From 1950 to 1967 he was affiliated with the Cleveland Clinic Foundation, ultimately as scientific director of the Artificial Organs Program. In 1967 he became professor of surgery and head of the Division of Artificial Organs at the School of Medicine of the University of Utah.

The artificial kidney dialysis machine Kolff invented has been perfected through a series of improvements so that there are over 400,000 people in the U.S. with end-stage renal disease that are being kept alive by this invention or a subsequent modification of it.

Kolff never patented his original machine, but after coming to the United States he headed a team which invented and tested the artificial heart.

Photo credit: Robert Maurer Collection

Robert D. Maurer

Fused Silica Optical Waveguide; Method of Producing Optical Waveguide Fibers

Patent Nos. 3,659,915; 3,711,262

Born July 20, 1924

Inducted in 1993

Corning Glass researchers Robert D. Maurer, Donald Keck, and Peter Schultz developed fiber-optic wire, capable of carrying thousands of times more information than conventional copper wire. In 1970 the trio designed and produced the first optical fiber with optical losses low enough for wide use in telecommunications. Previously, the limiting factor was the amount of light lost during transmission. The key was restricting light loss to 20 decibels per kilometer (at least one percent of the light entering a fiber remains after traveling one kilometer). Scientists around the world had worked on the problem for years to no avail. The discovery by the group at Corning was recognized as a breakthrough, paving the way for the commercialization of optical fiber and creating a revolution in telecommunications.

Optical fiber is the foundation for the global, multimedia telecommunications network of tomorrow. More than 90 percent of U.S. long-distance traffic is already carried on optical fiber; over 800 million kilometers have been installed, virtually all of it using the original design of Maurer, Keck, and Schultz.

Maurer was born in St. Louis. He earned a B.S. from the University of Arkansas in 1948 and a Ph.D. from the Massachusetts Institute of Technology in 1951. He joined the Corning Glass Works in 1952 and retired in 1989 as a research fellow.

Photo credit: Peter C. Schultz Collection

Peter C. Schultz

Fused Silica Optical Waveguide; Method of Producing Optical Waveguide Fibers

Patent Nos. 3,659,915; 3,711,262

Born December 3, 1942

Inducted in 1993

Fiber optics have become an integral part of our world since Peter C. Schultz, Robert Maurer, and Donald Keck found a way to produce an efficient optical fiber in 1970. The optical fiber produced by this team was based on pure silica glass and a unique method of vaporization. Up until that time, other researchers were using the traditional melting process to make glass fiber.

The team overcame two obstacles related to using silica. One was that it had a very high melting point, making it difficult to draw a fiber. The second obstacle was that it had the lowest refractive index of practically available glass; this was a problem because it would be used for the light carrying part of the fiber. Working together, the three men found a way to produce an optical fiber which carried the light by means of an inner core via an outside skin. The inner core was silica mixed with a dopant, a material that strengthened the refractive index of the light as it traveled along the fiber. Their successful result is widespread today.

Schultz was born in Brooklyn, New York, and received a B.S. in 1964 and a Ph.D. in ceramics in 1967 from Rutgers University. He joined Corning in 1967 as a senior ceramicist and later became president of Heraeus-Amersil, Inc. in Atlanta before his retirement in 2001.

Photo credit: Courtesy of Corning Incorporated

Donald B. Keck

Fused Silica Optical Waveguide; Method of Producing Optical Waveguide Fibers

Patent Nos. 3,659,915; 3,711,262

Born January 2, 1941

Inducted in 1993

Donald B. Keck worked with Robert Maurer and Peter Schultz at Corning Laboratories to create the first successful optical fiber in 1970. In the 1880s, Alexander Graham Bell tried to transmit voice signals along beams of light using his invention the Photophone. However, it did not prove to be practical or successful, and other inventors continuously tried to improve upon it. In the 1930s the idea surfaced that light could be carried along glass cables.

Upon further investigation in the 1960s, Keck, Maurer, and Schultz discovered that they could transmit sound in the form of light along a fiber of silica glass. This heralded the beginning of the fiber optic revolution. Born in Lansing, Michigan, Keck received a B.S. in 1962, an M.S. in 1964, and a Ph.D. in 1967, all from Michigan State University. He joined Corning as a research physicist in 1968. He went on to become vice president and executive director of research until his retirement in 2002. Keck and his colleagues received the National Medal of Technology in 2000.

Photo Credit: Amos Joel, Jr.

Amos Joel, Jr.

Mobile Communication System

Patent No. 3,663,762

Born March 12, 1918
Died October 25, 2008

Inducted in 2008

Amos Joel pioneered the system for cell phones of switching communication links from one cell region to another in response to movement, while maintaining continuity of service. His invention allows for convenient cell phone usage, making them a part of today's society. Joel was also responsible for developing the Traffic Service Position System (TSPS) used to automate the work of telephone operators and the Automatic Intercept System (AIS) created to automatically handle calls to non-working numbers.

A Philadelphia native, Joel was a world authority in the field of switching. He received bachelor's and master's degrees in electronic engineering from MIT. Soon after, he began his 43-year career with Bell Labs where he received over 70 U.S. patents in the field of telecommunications with an emphasis on switching.

During WWII, Joel designed circuits for early digital computers and was instrumental in the creation of cryptanalysis machines for military and diplomatic use.

Joel was recognized as Inventor of the Year by the New Jersey Congress of Inventors, and he received the Institute of Electrical and Electronics Engineers highest award, the Medal of Honor. His many other honors include the Kyoto Prize in 1989 and the National Medal of Technology in 1993.

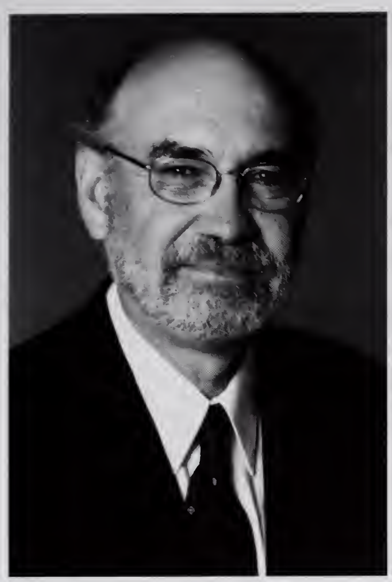

Photo credit: 3M

Spencer Silver

Acrylate Copolymer Microspheres

Patent No. 3,691,140

Born February 6, 1941

Inducted in 2010

In 1968, Spencer Silver was a senior scientist working to develop new classes of adhesives at 3M when he discovered an acrylic adhesive with unique properties. It was formed of tiny spheres that provided a pressure-sensitive adhesive with a high level of tack but a low degree of adhesion. Art Fry, a researcher at 3M, learned of the adhesive several years later. He coated paper with it and made repositionable notes, and the concept of Post-it® Notes was created.

Years of perfecting design and production followed. Major challenges involved creating equipment and processes to manufacture the notes, as well as the problem of getting the adhesive to stay in place and maintain a consistent range of adhesion.

Post-it Notes were introduced nationally in the United States in 1980. Repositionable notes are now among the five best-selling office products in the U.S., and when 3M received the National Medal of Technology in 1995, Post-it Notes were named among the products that helped the company earn the award.

Silver was born in San Antonio, Texas and received his Ph.D. from the University of Colorado. In 1966, he joined 3M, remaining there until his retirement in 1996. During his career, Silver pursued research in branch block copolymers, protein immobilization, immuno-diagnostics, and synthesized many new monomers used in pressure-sensitive adhesives. He is a member of the Carlton Society, the highest 3M honor. In 1998, he received the Medal for Creative Invention from the American Chemical Society.

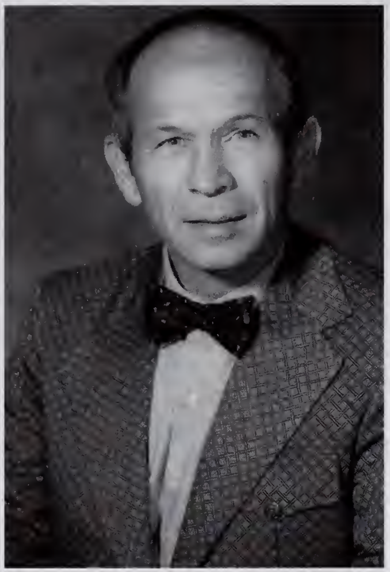

Photo Credit: Courtesy of NASA

Maxime Faget

Space Shuttle Vehicle and System

Patent No. 3,702,688

Born August 26, 1921
Died October 9, 2004

Inducted in 2003

Max Faget conceived and designed the first space capsule, Mercury, from which the designs for the Gemini capsule and the Apollo command and service modules were derived, as well as made major contributions to the design of the space shuttle. These designs were instrumental in the establishment and growth of the American space program.

Upon becoming Director of Engineering at the Johnson Space Center in Houston, Texas, Faget made his biggest advances in space capsule design. Faget understood a space capsule would have to withstand great G-Force and friction upon re-entering the earth's atmosphere. His design allowed for the spacecraft to slow down in the upper part of the atmosphere causing less friction and G-force. Faget continued as the Director of Engineering at NASA until 1981, when he co-founded Space Industries International to design an industrial space facility.

Born in British Honduras to American parents, Faget grew up in America and earned his degree from Louisiana State University in 1943. Faget is remembered as the chief designer of NASA's spacecraft from Project Mercury through the space shuttle. Winner of numerous awards including the Guggenheim Award and the NASA Medal for Outstanding Leadership, Faget received honorary doctorates from Louisiana State University and the University of Pittsburgh.

Photo Credit: *The John Charnley Trust*

John Charnley

Acetabular Sockets

Patent No. 3,722,002

Born August 29, 1911
Died August 12, 1982

Inducted in 2008

Sir John Charnley invented low-frictional torque arthroplasty, or LFA, the hip replacement surgery that has relieved the pain and restored the movement of hundreds of thousands of people.

Born in Lancashire, England, Charnley studied at Manchester University and trained at the Royal Manchester Infirmary and Salford Royal Hospital. He published seminal papers on the non-surgical treatment and surgical compression of fractures before beginning his work on hip replacement in 1954. Although the procedure had been done before, it generally resulted in pain due to pressure on nerves in the hip socket and poor lubrication of the joint.

In late 1962, Charnley unveiled a combination of a thick plastic socket and a small-diameter, highly-polished metal ball to replace the head of the thigh bone. He also developed a clean air enclosure, total body exhaust suits, and an instrument tray system that are essential to the replacement procedure. The Charnley hip replacement became the gold standard and has been a clinical success for more than four decades.

Charnley established the Center for Hip Surgery at Wrightington Hospital in 1962. There, he continued to develop LFA, and taught his methods to specialists, surgeons, and biomechanicians from around the world.

Photo credit: *Courtesy of Ralph H. Baer*

Ralph H. Baer

Television Gaming and Training Apparatus

Patent No. 3,728,480

Born March 8, 1922

Inducted in 2010

Engineer Ralph Baer, a pioneer in the field of interactive video games, invented what became known as the Magnavox Odyssey Home Video Game System. In 2004, the video game industry accounted for more than $8 billion in sales, with sales of $15 billion projected for 2010.

In the 1960s, Baer worked for defense contractor Sanders Associates. Although his primary focus was to develop military systems, Sanders thought that his gaming ideas could make money. Baer developed a number of games that became part of his "Brown Box," a multi-game console, including ping-pong, handball, soccer, volleyball, target shooting, checkers, and golf. Sanders licensed the technology to Magnavox, which introduced the Odyssey system in 1972.

Baer continued to work on interactive games during his years at Sanders, in addition to continuing his work on military electronics. A well-known game he developed was Simon, a single-chip, microprocessor controlled memory game introduced in 1978.

Born in Germany, Baer came to the United States as a teenager. After serving in the U.S. Army Military Intelligence during WWII, he attended the American Television Institute of Technology, receiving his B.S. in 1949. After a brief stint at Loral, Baer worked at Sanders until 1987 before devoting all of his time to his own consulting business. In 2004, Baer was a recipient of the National Medal of Technology.

Photo credit: Courtesy of Jack Mackenzie

James L. Fergason

Display Devices Utilizing Liquid Crystal Light Modulation

Patent No. 3,731,986

Born January 12, 1934
Died December 9, 2008

Inducted in 1998

James Fergason held a series of patents that form the foundation of the multi-billion dollar LCD industry which has been rapidly growing since 1971. LCD technology, starting with quartz watches and calculators, has completely redefined many industries, such as computer displays, medical devices, industrial devices, and the vast array of consumer electronics.

Fergason was born in Wakenda, Missouri and attended the University of Missouri. After graduating, he formed and led the first industrial research group in liquid crystal research while at Westinghouse Research Laboratories in Pennsylvania. There, he invented the first practical uses of liquid crystals. He joined the Liquid Crystal Institute at Kent State University in Ohio in the 1960s. While Associate Director, Fergason discovered the twisted nematic field effect of liquid crystals which forms the scientific basis of modern LCDs.

In 1970, Fergason made the first operating LCDs. Prior to this invention, LCDs used a large amount of power, provided a limited life, and had poor visual contrast. In 1971, the first LCDs were demonstrated publicly and enthusiastically accepted. Fergason, who held over 100 U.S. patents, founded Fergason Patent Properties in 2001 as an intellectual property development and licensing company.

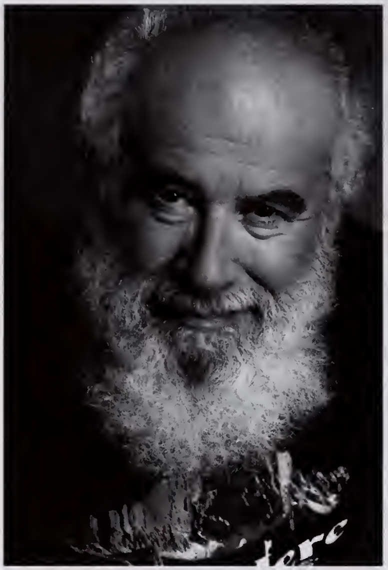

Photo credit: Courtesy of Dov Frohman-Bentchkowsky

Dov Frohman-Bentchkowsky

Electrically Programmable Read Only Memory Array

Patent No. 3,744,036

Born March 28, 1939

Inducted in 2009

Dov Frohman-Bentchkowsky invented a computer chip that could be erased by exposing it to ultraviolet light, then have new data written onto it. Before Frohman's erasable programmable read only memory chip, or EPROM, memory chips were either "volatile," meaning that they would lose their contents if they lost power, or "read only," meaning that they were stable without power but could only be encoded at the factory – an expensive and time-consuming process. Frohman's EPROM combined the best of both concepts, providing nonvolatile erasable memory.

In the 1970s, Frohman's employer Intel paired his EPROM invention with their new microprocessors to develop the foundations for personal computing. Today's complex electronic devices — our cell phones, digital cameras, MP3 players, and computers – all rely on a form of nonvolatile memory (mainly "Flash" memories) to store their operating systems.

Born in Amsterdam, The Netherlands and educated at the Israel Institute of Technology and the University of California at Berkeley, Frohman began his career at Fairchild Semiconductor in 1965. He moved to Intel in 1969 and soon established Intel design and fabrication facilities in Israel. Frohman retired from Intel in 2001.

Photo credit: National Inventors Hall of Fame®, Invent Now, Inc.

Roger Easton

Navigation System Using Satellites and Passive Ranging Techniques

Patent No. 3,789,409

Inducted in 2010

TIMATION is an acronym of TIMe navigATION, proposed by the U.S. Naval Research Laboratory (NRL). Timation was developed by Roger Easton for the Naval Air Systems Command. The current Global Positioning System (GPS) is based on the Timation system, and their principles of operation are fundamentally identical. One of the significant advantages of such a system is that its user size is unlimited.

Timation provided both accurate positions and precise time to observers. Today, GPS has a constellation of earth-orbiting satellites providing precise navigation and timing data to military and civilian users. The rapidly growing GPS market, including equipment and applications, is expected to surpass $50 billion in 2010. At NRL, Easton also worked on Project Vanguard, designing a satellite to be sent into orbit and on Minitrack, a system designed to track all earth-orbiting satellites.

Born in Craftsbury, Vermont, Easton attended Craftsbury Academy and Middlebury College, and after attending the University of Michigan for one semester, he joined NRL. He spent his career at NRL until his retirement in 1980, continuing to consult for a number of years. In 2006, he received the National Medal of Technology

Photo credit: Courtesy of Fonar Corporation

Raymond V. Damadian

Apparatus and Method for Detecting Cancer in Tissue

Patent No. 3,789,832

Born March 16, 1936

Inducted in 1989

Raymond Damadian invented the magnetic resonance imaging (MRI) scanner, which has revolutionized the field of diagnostic medicine. Born in Forest Hills, New York, Damadian attended the Julliard School of Music for eight years, studying violin. He received his B.S. from the University of Wisconsin and an M.D. degree from the Albert Einstein College of Medicine in New York. Damadian later served as a fellow in nephrology at Washington University School of Medicine and as a fellow in biophysics at Harvard University. He studied physiological chemistry at the School of Aerospace Medicine in San Antonio, Texas. After serving in the Air Force, Damadian joined the faculty of the State University of New York Downstate Medical Center in 1967. His training in medicine and physics led him to develop a new theory of the living cell, his Ion Exchanger Resin Theory.

His MRI produced images of the interior of the body far more detailed than was possible with X-ray devices such as the CAT scanner. The MRI obtains information through the use of static and dynamic magnetic fields, a method that yields radio signal outputs from the body's tissue that can be either transformed into images or analyzed to provide the chemical composition of the tissue being examined. Damadian founded the Fonar Corporation in 1978 for the manufacture of the MRI scanner. Since the device's approval in 1984 by the FDA, hundreds have been put to use around the world.

Photo credit: Courtesy of Corning, Inc.

Rodney D. Bagley

Extrusion Method for Forming Thin-Walled Honeycomb Structures

Patent No. 3,790,654

Born October 2, 1934

Inducted in 2002

Rodney Bagley was on the Corning team that created the ceramic substrate inside catalytic converters. His work was instrumental in allowing the automotive industry to meet standards set by the 1970 U.S. Clean Air Act.

Bagley developed the extrusion die and process that made a thin-walled, honeycombed cellular ceramic substrate. Thousands of cellular channels through the structure allowed for a large surface area. The inside surface area was then coated with a catalyst that reacted with pollutants, resulting in harmless emissions, including carbon dioxide, nitrogen, and water vapor. Another feature of the ceramic substrate was that due to its sensitivity, only lead-free gasoline could be used. Since the 1970s, vehicles equipped with advanced emission controls have reduced pollutants by over three billion tons worldwide.

Born in Ogden, Utah, Bagley attended the University of Utah, receiving his B.S. in geological engineering in 1960 and his Ph.D. in ceramic engineering in 1964. In 1963, he joined Corning and researched unique ceramic materials until his retirement in 1994. A Corning Research Fellow, Bagley is also a Fellow of the American Ceramic Society and a 1985 recipient of their Geijsbeck Award. Additional awards include the 1996 International Ceramics Prize, the 1990 Mountain Man of the Year Award from the University of Utah, and the 2003 National Medal of Technology.

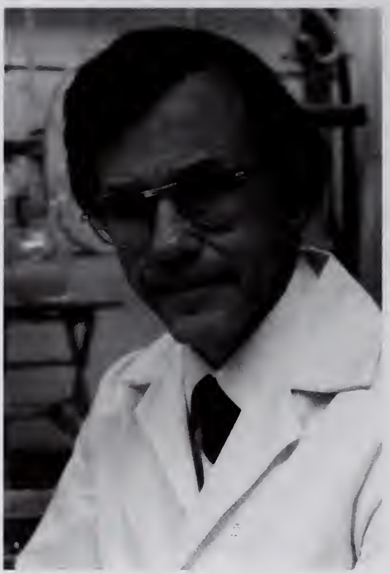

Photo credit: Courtesy of John Franz

John E. Franz

N-phosphonomethyl-Glycine Phytotoxicant Compositions

Patent No. 3,799,758

Born December 21, 1929

Inducted in 2007

In 1970, chemist John Franz discovered the glyphosate class of herbicides. The broad-spectrum, post-emergence, glyphosate-containing herbicide Roundup® eliminates over 125 kinds of annual and perennial weeds. It is not active in soil and is readily metabolized to innocuous products.

Glyphosate inhibits a key enzyme found primarily in plants, having no effect on mammals, birds, fish, or insects. Roundup allows farmers to control weeds with minimal tillage, conserving topsoil, time, and fuel.

Franz was born in Springfield, Illinois. He received his B.S. and Ph.D. degrees at the University of Illinois and the University of Minnesota. He commenced work at Monsanto Company in 1955 and retired in 1991. Franz was awarded the National Medal of Technology in 1987 and the Perkin Medal in 1990. He holds over 840 U.S. and foreign patents.

At Monsanto, two awards have been created in Franz's honor. The Franz Sustainability Award annually recognizes an environmental project in conservation, technology, or education. The Franz Innovation Award Scholarship is given annually to an organic chemistry graduate student at the University of Minnesota.

Photo credit: Courtesy of Yvonne Brill

Yvonne Brill

Dual Thrust Level Monopropellant Spacecraft Propulsion System

Patent No. 3,807,657

Born December 30, 1924

Inducted in 2010

Yvonne Brill is known for her innovations in rocket propulsion. Her most important contributions are advancements in rocket propulsion systems for geosynchronous communications satellites in the form of the hydrazine/hydrazine resistojet propulsion system, or the electrothermal hydrazine thruster (EHT). Early on, Brill saw the importance of the system for the then-fledgling communications satellite industry.

Brill's EHT, which electrically heats the rocket fuel hydrazine, is unique because it extends the utility of the monopropellant hydrazine system by increasing performance by adding heat to the propellant decomposition products to give a thirty percent increase in efficiency. Because of its increased efficiency, her invention allows for a reduction in propellant weight since previously, additional propellant was needed to keep the satellite in its proper station on-orbit. The EHT is standard in industry. Since 1983, companies such as RCA, GE, Lockheed Martin and Orbital Sciences have used EHTs on their communications satellites.

A native of Winnipeg, Canada, Brill received her undergraduate degree from the University of Manitoba and her M.S from the University of Southern California. Beginning her career at Douglas Aircraft on the west coast, she eventually joined RCA Astro Electronics in the east. She also spent time with NASA and the International Maritime Satellite Organization. Among her many honors, Brill has been awarded the AIAA Wyld Award and AAES John Fritz Medal.

Photo credit: Courtesy of DuPont

Stephanie Louise Kwolek

Optically Anisotropic Aromatic Polyamide Dopes and Oriented Fibers Therefrom

Patent No. 3,819,587; RE. 30,352

Born July 31, 1923

Inducted in 1995

Thousands of police can attest to the value of Stephanie Kwolek's breakthrough research in para-aramid fibers. The fruits of her inventiveness can be found in mooring ropes, fiber-optic cables, aircraft parts, canoes, and lightweight bullet-resistant vests. Born in New Kensington, Pennsylvania, Kwolek received her B.S. in chemistry from the Carnegie Institute of Technology in 1946. That same year she went to work as a chemist at the Buffalo, New York, site of E.I. du Pont de Nemours & Company.

As she carried out experiments to make stronger and stiffer fibers, she discovered an amazing branch of polymer science–liquid crystalline polymers. The most famous product of her discovery was Kevlar®, a polymer fiber five times stronger than the same weight of steel. The material of choice for bullet-resistant vests and many other applications generates hundreds of millions of dollars in sales worldwide each year. Kwolek moved to the pioneering Research Laboratory at DuPont's Experimental Station in Wilmington, Delaware, in 1950. She retired in 1986 as a research associate but continues to consult for DuPont and serves on the committees of the National Research Council and the National Academy of Sciences.

Photo credit: Jon Brenneis

Marcian E. (Ted) Hoff

Memory System for a Multi-Chip Digital Computer

Patent No. 3,821,715

Born October 28, 1937

Inducted in 1996

Marcian "Ted" Hoff, Jr. led the team at Intel that designed the first single-chip computer CPU. Hoff was born in Rochester, New York and received his undergraduate degree in 1958 from Rensselaer Polytechnic Institute. He attended Stanford University as a National Science Foundation Fellow, receiving an M.S. in 1959 and a Ph.D. in 1962.

In the late 1960s, there was a great deal of discussion regarding the possibility of a computer on a chip. Ted Hoff was the first to recognize that Intel's new silicon-gated MOS technology might make a single-chip CPU possible if a simple enough architecture could be formed. Hoff developed this architecture with just over 2000 transistors. One of the most important developments of the last half of the 20th century has been the microprocessor. It is found in virtually every electronic device in the modern world. From its inception in 1969, the microprocessor industry has grown to hundreds of millions of units per year.

Hoff joined Intel in 1962. In 1980, he was named the first Intel Fellow, the highest technical position in the company. He spent a brief time as VP for Technology with Atari in the early 1980s and was Chief Technologist with Teklicon, Inc. until his retirement in 2009. Other honors include the Stuart Ballantine Medal from the Franklin Institute.

Photo credit: Courtesy of Stanley Mazor

Stanley Mazor

Memory System for a Multi-Chip Digital Computer

Patent No. 3,821,715

Born October 22, 1941

Inducted in 1996

Stanley Mazor was instrumental in refining the architecture and logic design of the single-chip CPU. This first working microprocessor was smaller than a thumbnail yet had as much computing power as ENIAC, the first electronic computer, which filled 3,000 cubic feet. Born in Chicago, Mazor went on to study mathematics and programming at San Francisco State University. He worked first as a programmer for Fairchild Semiconductor and then as a computer designer. He shares patents on the Symbol computer.

In 1969, he joined Intel. Mazor was part of the team that created the first working CPU, the 4004. The 4004 was designed and built under contract for Busicom, a Japanese calculator manufacturer—they owned the rights to it. Intel acquired the rights by offering to return the $60,000 development cost and to produce the chip at a lower cost. Thus began the modern computer revolution.

In 1977, he began his teaching career in Intel's Technical Training group, and later taught classes at several institutions, including Stanford University and the University of Santa Clara. In 1984, he was at Silicon Compiler Systems. He co-authored a book on chip design language during time at Synopsys and also was Training Director at BEA Systems. He retired from Numeric Technologies/Synopsys in 2004.

Photo credit: Courtesy of Federico Faggin

Federico Faggin

Memory System for a Multi-Chip Digital Computer

Patent No. 3,821,715

Born December 1, 1941

Inducted in 1996

Federico Faggin joined Intel in 1970 to bring the design of the first microprocessor to silicon reality. Since it was first introduced in 1971, the microprocessor has found its place in virtually every electronic item in the modern world. The vast array of electronic items that use microprocessors include personal computers, traffic lights, and VCRs.

Born in Vicenza, Italy, Faggin graduated from Instituto Industriale at Vicenza in 1960 and received a doctorate in physics from the University of Padua in 1965. In 1968, he came to the United States to join Fairchild in Palo Alto, California where he developed the original silicon gate technology. The 4004 CPU project brought him to Intel in 1970. Faggin was also involved in Intel's second and third generation CPUs, the 8008 and 8080.

After his work with Intel, Faggin went on to found Zilog, Inc. in 1974, which produced a new chip design, the Z-80, for the fledgling personal computer industry. After a short stint with Exxon, he co-founded Cygnet Technologies in 1982. He then formed Synaptics, Inc. in 1986 to design a network of circuits that replicate human thinking. Faggin is a recipient of the Marconi Fellowship and the IEEE W. Wallace McDowell award.

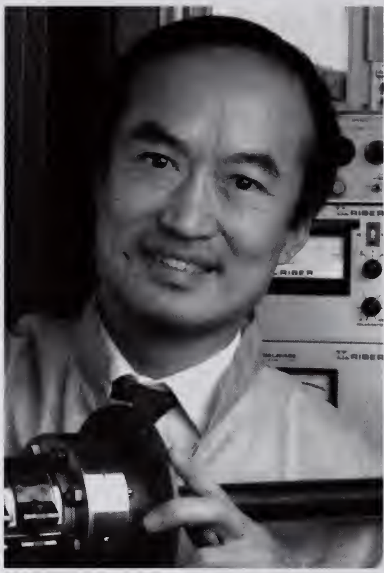

Photo credit: Reprinted with permission of Alcatel-Lucent

Alfred Y. Cho

Optical Devices Utilizing Single Crystal GaP or GaAs Films Epitaxially Grown on CaF Substrates and Method of Fabricating the Same

Patent No. 3,830,654

Born July 10, 1937

Inducted in 2009

Alfred Cho is considered "the father of molecular beam epitaxy," a process in which materials are layered atop one another – atom-by-atom within a vacuum — with great precision to form devices like transistors and light-emitting diodes, or lasers. Cho achieved many firsts with this technique, including producing the first of several types of diodes and the first field effect transistor that operates at microwave frequencies. The switches in cell phones that carry our conversations over radio frequencies are made using molecular beam epitaxy, as are most of the lasers used in CD/DVD players and drives.

Because molecular beam epitaxy can produce compounds that do not exist in nature, it is used for research purposes as well, and as a real-world demonstration of quantum physics to university students worldwide.

Cho was born in Beijing, China and earned bachelor's, master's, and doctorate degrees from the University of Illinois. His early work was for Ion Physics Corp. and TRW Space Technology Labs. He joined Bell Laboratories after completing his Ph.D. in 1968, where he ultimately became Vice President of Semiconductor Research for Alcatel-Lucent's Bell Labs. He is the recipient of many awards, including the National Medal of Science and the National Medal of Technology.

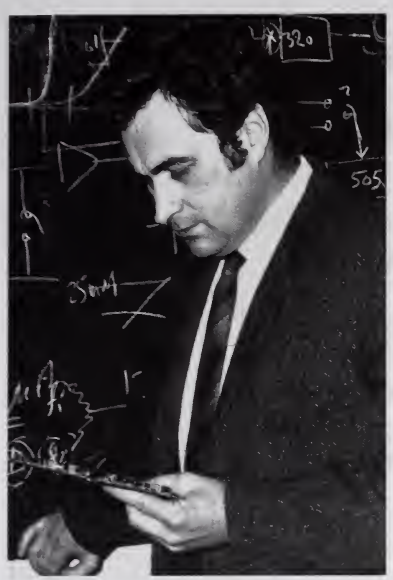

Photo credit: Courtesy of Dolby Laboratories

Ray Dolby

Noise Reduction Systems

Patent No. 3,846,719

Born January 18, 1933

Inducted in 2004

Ray Dolby revolutionized the audio industry in the 1960s by inventing the Dolby System, which electronically reduced the pervasive "hiss" from analog tape sound recording, thus creating a clearer, crisper sound. With the Dolby System, sound is passed through an encoder as it is recorded, then played back through a decoder, dramatically lowering background noise and hiss with none of the side effects inherent in previous attempts at noise reduction.

Ray Dolby was born in Portland, Oregon. He received a B.S. in electrical engineering from Stanford University and a Ph.D. in physics from Cambridge University. He founded Dolby Laboratories in 1965 to develop his ideas about noise reduction.

The following year, Decca Records became the first recording company to use the Dolby System. By 1967, major record labels such as RCA, MCA, and CBS followed suit. The 1970s saw the use of Dolby technology in film production and exhibition, in movies such as *Apocalypse Now* and *Star Wars*.

Photo credit: Lucent Technologies/Bell Labs

Willard S. Boyle

Information Storage Devices

Patent No. 3,858,232

Born August 19, 1924

Inducted in 2006

Willard S. Boyle and George E. Smith invented the charge-coupled device (CCD), a light-sensitive microchip that enabled dramatic advances in digital imaging technology. CCDs are found in most imaging devices including digital cameras, scanners, and fax machines.

Born in Nova Scotia, Boyle was home schooled until grade nine. After training as a pilot for the Canadian Navy during World War II, he went on to earn a Ph.D. from McGill University, Montreal. While working at Bell Labs in 1969, Boyle and Smith sketched out the basic CCD in about an hour, and built a working prototype in under a week.

The charge-coupled device stores information in discrete packets of electric charge in columns of closely spaced semiconductor capacitors. Stored information is read by shifting stored charges down the columns, one position at a time. The CCD's ultra-sensitivity to light makes it an important tool for scientists. Most telescopes, including the Hubble Space Telescope, rely on CCDs for electronic imaging.

Boyle's major contributions include the first continuously operating ruby laser and the first patent proposing a semiconductor injection laser. In 2009, he and George Smith were awarded the Nobel Prize in Physics.

Photo credit: Courtesy of George Smith

George E. Smith

Information Storage Devices

Patent No. 3,858,232

Born May 10, 1930

Inducted in 2006

Physicists George Smith and Willard Boyle invented the charge-coupled device (CCD) while working at Bell Labs in 1969. Smith, working to improve video telephone technology, and Boyle, charged with creating a new semiconductor memory chip for computers, sketched out the basic CCD in an hour or so. In less than a week, they had a working prototype.

The CCD is a silicon-based integrated circuit that converts light energy into an electronic charge. While not successful as a memory device, the CCD was key to dramatic advances in digital imaging technology. CCDs provide video imaging devices with a wide range of applications, including broadcasting, digital cameras, endoscopy, desktop videoconferencing, fax machines, and bar code readers. The CCD's sensitivity enables astronomers to study objects thousands of times fainter than they could with photographic plates.

Smith was born in White Plains, New York, attaining his B.S. at the University of Pennsylvania in 1955 and his Ph.D. from the University of Chicago in 1959. He joined Bell Labs in 1959, retiring in 1986. He holds 30 patents and was awarded the IEEE Morris Liebman Award in 1974 for his work on the CCD. In 2009, Smith and Willard Boyle were awarded the Nobel Prize in Physics.

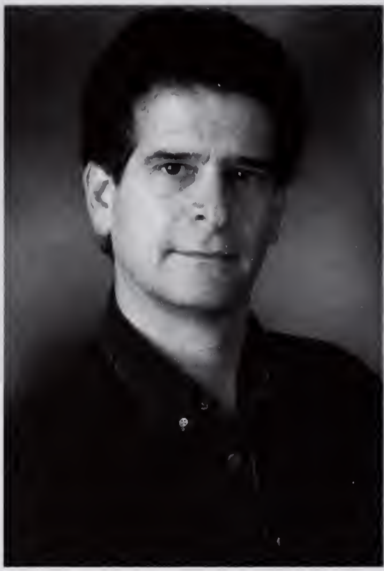

Photo credit: DEKA Research & Development

Dean Kamen

Medication Injection Device

Patent No. 3,858,581

Born April 5, 1951

Inducted in 2005

Dean Kamen's first major innovation was the AutoSyringe®, a class of automatic, self-contained ambulatory infusion pumps designed to free patients from round-the-clock injections and, in some cases, from their hospital beds. The wearable device delivered precise doses of medication to diabetics and other patients with a variety of medical conditions. Using an AutoSyringe® to reliably dispense medication (such as insulin) gave patients greater freedom and control over their disease, dramatically improving their quality of life, while reducing complications and painful daily injections.

Born in Rockville Center, New York, Kamen's natural aptitude for inventing was obvious from childhood. By the time he was a young adult, he was already established as a serious independent inventor. Among his inventions in the medical field are a portable peritoneal dialysis machine and the IBOT, a sophisticated mobility aid capable of climbing stairs and raising the user to eye-level with a standing person.

Among Kamen's proudest accomplish-ments is founding FIRST (For Inspiration and Recognition of Science and Technology) in 1989. The organization is dedicated to motivating the next generation to understand, use, and enjoy science and technology.

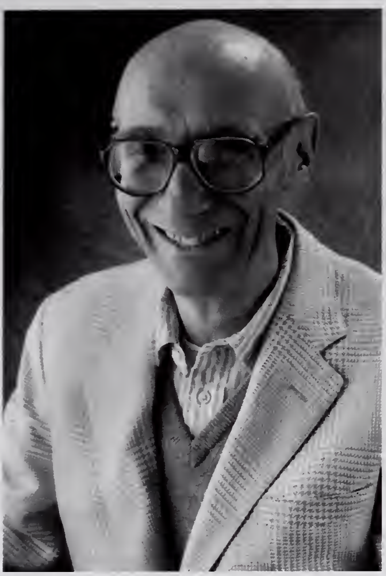

Photo credit: Courtesy of Irwin Lachman

Irwin M. Lachman

Anisotropic Cordierite Monolith

Patent No. 3,885,977

Born August 2, 1930

Inducted in 2002

Working at Corning, Irwin Lachman co-invented the ceramic substrate found in virtually all catalytic converters. Catalytic converters provide cleaner automotive emissions, greatly reducing harmful pollutants.

Lachman and his colleagues were critical in developing an efficient and feasible catalytic converter. Lachman realized ceramics could be ideally suited to meet the demands placed on a catalytic converter. The advanced ceramic composition he worked on provided superior resistance to sudden and extreme temperature fluctuations. Today, Lachman's fundamental ceramics technology extends to substrates for trucks, buses, and motorcycles, further decreasing pollution released into the environment.

Lachman was born in Brooklyn, New York and then moved with his family to New Jersey, attending the public schools. He received a B.S. in ceramic engineering from Rutgers University in 1952, and an M.S. and a Ph.D. in ceramic engineering from Ohio State University in 1953 and 1955. After serving with the U.S. Air Force, he worked at Thermo Materials, Inc., and the Sandia National Laboratory before joining Corning in 1960. A Corning Research Fellow, Lachman retired in 1994 and pursues his artistic interests by creating monoprints that he exhibits at galleries and in shows. Lachman is the recipient of the 2003 National Medal of Technology.

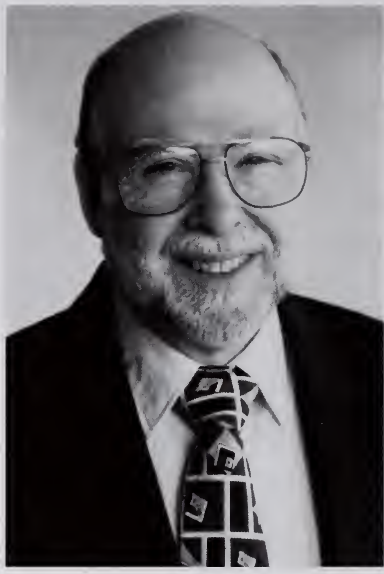

Photo credit: *Courtesy of the National Inventors Hall of Fame®, Invent Now, Inc.*

Ronald M. Lewis

Anisotropic Cordierite Monolith

Patent No. 3,885,977

Born February 18, 1936

Inducted in 2002

Ronald Lewis is co-inventor of the ceramic substrate found in catalytic converters, the device used on cars to reduce pollutants into harmless byproducts. A unique quality of the ceramic is its very low thermal expansion, making it extremely resistant to thermal shock, a necessary requirement for durability. He discovered that inducing the proper preferred orientation of the crystallites in the substrate is vital to obtaining the low thermal expansion.

Additional qualities of the ceramic are that it provides a properly textured surface for the catalyst, it is phase stable, resistant to corrosion, and it can withstand very high operating temperatures. Today, every car company relies on ceramic technology to control exhaust emissions, and over 500 million vehicles have catalytic converters.

A native of New York City, Lewis graduated from the Bronx High School of Science. He attended the City College of New York, majoring in geology and graduating with a B.S. in 1957. He completed graduate work in mineralogy and petrology at the Pennsylvania State University. Lewis joined Corning in 1966 as research mineralogist; among his major projects there was his work with the ultra-low thermal expansion ceramic for the catalytic converter. Lewis is the recipient of the 2003 National Medal of Technology.

Photo credit: Courtesy of John Macdougall

John Macdougall

Method of Making Insulated Field Gate Transistor with Controlled Threshold Voltage

Patent No. 3,895,966

Born June 19, 1940

Inducted in 2009

John Macdougall is one of the inventors of the first commercially viable method of ion implantation, a process that changes the conductivity of areas of a silicon wafer — or "dopes" them — by bombarding them with ionized atoms. When the wafer is heated, each implanted atom replaces a silicon atom. This permits very precise construction of different areas of conductivity. When linked together, these form the components of an integrated circuit.

Macdougall and his colleagues built an ion implantation machine from scratch at Sprague Electric Co., which was one of the major investors in MOSTEK, a start-up integrated circuit manufacturer. MOSTEK's leadership recognized the importance of ion implantation and had a commercial-scale, automated machine – probably the world's first—built by Accelerators Inc. in Texas, and installed first in their Massachusetts facility and later in their Texas plant. MOSTEK had invested everything in the ion bombardment process. If the products that resulted had failed, the company would have as well. Today, ion implantation is the dominant doping method in the production of integrated circuits.

Born in Sussex, New Brunswick, Canada, Macdougall received a B.Sc. from the University of New Brunswick in 1962 and a Ph.D. from McMaster University in 1966. He has been employed by Sprague Electric and its successor company Allegro Microsystems throughout his career.

Photo credit: Courtesy of Ken Manchester

Ken Manchester

Method of Making Insulated Field Gate Transistor with Controlled Threshold Voltage

Patent No. 3,895,966

Born March 22, 1925

Inducted in 2009

Ken Manchester is a pioneer in the development of ion implantation, a process in which silicon is bombarded with ionized atoms to change the electrical conductivity of certain areas – a process called "doping." This method can produce very precise electrical junctions. Junctions form transistors; many transistors packaged on a chip form an integrated circuit.

In 1965, Manchester and his colleagues built one of the first transistors fabricated entirely with ion implantation. While that device was an experiment, within a few years Manchester and his coworker John Macdougall had constructed functioning integrated circuits using their laboratory constructed ion implantation machine. Before long, they would be helping to design the first ion implantation apparatus for producing integrated circuits on a commercial scale for the start up company MOSTEK, in which their employer Sprague Electric was an investor. Currently, very precise doping in the integrated circuit industry is performed using ion implantation.

A native of Winona, Minnesota, Manchester received a bachelor's degree from San Jose State College in 1949 and a Ph.D. from Stanford University in 1955. He joined Sprague Electric Co. in 1962, where he worked until his retirement in 1989, and he consulted with Allegro Microsystems until 1996.

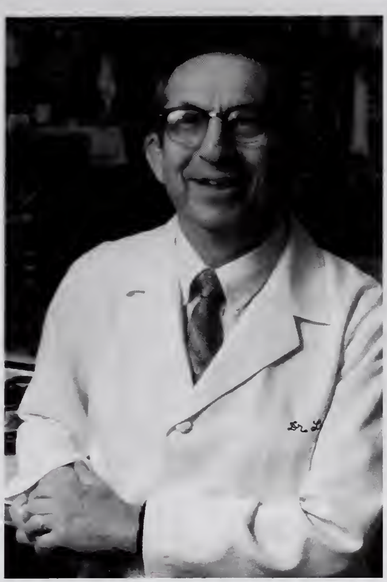

Photo credit: *Courtesy of Second Source Publications, Inc.*
Business Publishers for Medical Terminology Management

Robert S. Ledley

Diagnostic X-Ray System

Patent No. 3,922,552

Born June 28, 1926

Inducted in 1990

Robert S. Ledley invented the whole-body CT (computerized tomographic) diagnostic X-ray scanner. Born in New York City, Ledley earned a D.D.S. from New York University in 1948 and an M.A. from Columbia University in 1949. Eventually, he became professor of physiology, biophysics, and radiology at the Georgetown University Medical Center.

Ledley is best known for the ACTA (Automatic Computerized Transverse Axial) diagnostic X-ray scanner, the first whole-body computerized tomography (CT) machine. The ACTA Scanner set the basic design for modern CT scanners, including the first use of the convolution method for CT-image reconstruction, the first high-resolution digital TV display for medical imaging, and the tilting gantry. Ledley also revolutionized diagnostic medicine by doing medical imaging and three-dimensional reconstructions using CT in radiation therapy planning and in the diagnosis of bone diseases.

In addition to the ACTA scanner, Ledley patented the image processor and wrote the first comprehensive textbook for engineers on digital computer engineering. He also developed the computational methods in Boolean algebra, used in digital circuit design. In 1960, he founded the National Biomedical Research Foundation, and he has also served as editor of several peer-reviewed scientific journals.

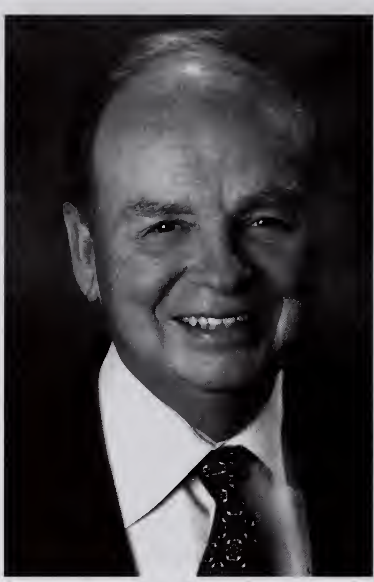

Photo credit: Honeywell Corporation

C. Donald Bateman

Aircraft Landing Approach Ground Proximity Warning System

Patent No. 3,922,637

Born March 8, 1932

Inducted in 2005

C. Donald Bateman invented the Ground Proximity Warning System (GPWS), one of a series of innovations he developed to dramatically improve aircraft safety.

Tragic airplane crashes during the 1960s prompted airline owners to seek ways to improve a pilot's ability to know if he is flying too low or approaching a mountain. Bateman responded with a device that automatically warned pilots if their aircraft were approaching the ground or water. The system worked so well that the Federal Aviation Administration began requiring GPWS in aircraft in 1973.

As technology improved, Bateman and his team of developers created a series of advances that made their warning systems more effective and reliable. They added more sophisticated ways of determining the distance from the aircraft to threatening terrain, providing wind shear warnings, integrated other avionics systems, and included computerized colored pictures of topographical data. His innovations to the landing system, specifically the Enhanced Ground Proximity Warning System, continue to advance safety within the aviation industry.

Born in Saskatchewan, Canada, Bateman studied at the University of Saskatchewan, where he received his degree in electrical engineering. He continues to work on EGPWS at Honeywell.

Photo credit: The MIT Museum

John C. Sheehan

Displacement of the Thiazolidine Ring in Penicillin with the Formation of a Biologically Active Cephem System

Patent No. 3,939,151

Born September 23, 1915
Died March 21, 1992

Inducted in 1995

Sir Alexander Fleming's 1928 discovery of penicillin in bread mold was a tremendous breakthrough for medical science. Unfortunately, Fleming's process for harvesting the antibiotic took months to generate a small amount. During World War II, as demand for penicillin rose, researchers worked feverishly to synthesize the penicillin molecule. More than a thousand scientists in 39 U.S. labs became involved in the project. But when the war ended and the molecule still had not revealed its structure, the funds for research ended. From 1948 to 1957 only one laboratory continued the research—John Sheehan's. In March of 1957, Sheehan announced the first rational total synthesis of natural penicillin. The next year he reported a general total synthesis of penicillins.

Born in Battle Creek, Michigan, Sheehan graduated from Battle Creek College and received his master's and Ph.D. degrees from the University of Michigan. He began a 31-year teaching career at MIT in 1946. At the beginning of World War II, Sheehan and W.E. Bachmann of the University of Michigan devised a new and practical method of manufacturing the military high explosive RDX (cyclonite), which replaced TNT as the basic explosive for rocket, bomb, and torpedo warheads.

In 1953 and 1954 he served as a scientific liaison officer with the American Embassy in London for the Office of Naval Research. He was later a scientific adviser to presidents Kennedy and Johnson.

Photo credit: *Bill Hartough, The University of Toledo*

Graham J. Durant

Pharmacologically Active Guanidine Compounds

Patent Nos. 3,950,333; 4,024,271

Born March 14, 1934
Died March 11, 2009

Inducted in 1990

Graham John Durant, John Emmett, and Robin Ganellin led the SmithKline Beecham Corporation's research team that discovered the H2 receptor class of drugs, including cimetidine, which inhibits the production of stomach acid. The World Health Organization lists cimetidine, known originally as Tagamet, as one of the world's most essential drugs for its ability to heal ulcers without surgery.

During inflammatory and allergic reactions, histamines are released. This causes hayfever, and also stimulates gastric acid secretion. However, antihistamine drugs of this century failed to inhibit gastric acid secretion, so prior to Tagamet, bland diets and nonprescription antacids were the only help other than surgery for ulcers. Even after surgery, many patients suffered relapses.

Born in Newport, Great Britain, Durant studied at Birmingham University where he received his B.Sc. and his Ph.D., and at the State University of Iowa. He was the named inventor or co-inventor of more than 150 U.S. patents in H2 antagonists and several other drug classes. He relocated to the United States in 1987, established the Center for Drug Design and Development at the University of Toledo, Ohio and was its director until 1992. He later became senior director of chemistry at Cambridge NeuroScience Inc.

Photo credit: John Emmett's Personal Collection

John Colin Emmett

Pharmacologically Active Guanidine Compounds

Patent Nos. 3,950,333; 4,024,271

Born April 27, 1939

Inducted in 1990

With Graham Durant and Robin Ganellin at SmithKline Beecham Corporation, John Colin Emmett worked to discover the H2 receptor class of drugs. Their accomplishment helped establish a physiological role for histamines in the control of gastric acid secretions, the major cause of duodenal ulcers.

Prior to this team's discovery, ulcer patients were encouraged to rest, to keep away from work, to avoid alcohol and smoking, and to have a bland, near-tasteless diet. Once cimetidine (C10H16N6S) was introduced under the brand name Tagamet, some individuals who had suffered throughout their entire lifetimes with ulcers felt a total absence of pain after only a week or two of treatment. It proved to be a highly successful product in both the speed and the magnitude of its acceptance after being introduced to the United States in 1977. In 1994, the patent on cimetidine expired; it is now marketed under additional brand names.

Born in Bradford, Yorkshire, England, Emmett read chemistry at Queen Mary College, London University for his B.Sc. and his Ph.D. and also studied at Yale University. He is currently a consultant with Euromedica Ltd. Emmett is listed as co-inventor on more than 100 U.S. patents in the fields of H2 antagonists, selective phosphodiesterase inhibitors, and selective thyromimetics.

Photo credit: Courtesy of The Welwyn and Hatfield Times

Charon Robin Ganellin

Pharmacologically Active Guanidine Compounds

Patent Nos. 3,950,333; 4,024,271

Born January 25, 1934

Inducted in 1990

In 1964, C. Robin Ganellin began work with Graham Durant and John Emmett that led to the discovery of histamine blockers and that eventually propelled the drug cimetidine to be placed on the essential drug list compiled by the World Health Organization. The team worked in collaboration with Nobel laureate biologist Sir James Black, and cimetidine was introduced to the world in 1976 under the brand name Tagamet.

Many physicians divide the history of ulcer disease into two areas—before cimetidine and after cimetidine. Cimetidine works by inhibiting gastric acid secretion when treating duodenal ulcers. In 1989, it was the first H2 antagonist to receive approval for continuous intravenous infusion, and in 1988, it became the first drug approved for the once-daily treatment of gastric ulcers. Another reason cimetidine is hailed is because ulcer patients can now lose less work days and have fewer operations.

Ganellin was born in London, England, and studied chemistry at Queen Mary College, London and at the Massachusetts Institute of Technology. He is currently the SmithKline and French professor of medicinal chemistry at University College London, where he is also researching into cholecystokinin and potassium ion channels. Ganellin is named as co-inventor on more than 150 U.S. patents.

Photo Credit: Courtesy of Richard Whitcomb

Richard Whitcomb

Airfoil Shape for Flight at Subsonic Speeds

Patent No. 3,952,971

Born February 21, 1921
Died October 13, 2009

Inducted in 2003

Richard Whitcomb, an aerodynamicist working for NASA, studied the causes of high airplane drag near the speed of sound and invented shapes reducing this drag. In his research he discovered the Area Rule, a method for predicting the large increases in drag at the speed of sound. Using this concept, he invented the "wasp-waisted" fuselage, which greatly reduces these drags. It allowed substantial increases in speed without increases in power.

Whitcomb also invented the supercritical wing. Compared with conventional wings, it is flatter on top and rounder on the bottom with substantial downward curvature rearward. It significantly delays the severe increase in drag below the speed of sound. It is now common on jet transport airplanes. In addition, Whitcomb invented winglets, vertical wing-like surfaces at the tips of transport wings. They reduce drag at cruise conditions.

Born in Evanston, Illinois, Whitcomb attended Worcester Polytechnic Institute. A trailblazer in aerodynamics, he was awarded the Collier Trophy, the Wright Brothers Memorial Trophy, and the National Medal of Science.

Photo credit: Eric Crossan

Robert W. Gore

Process for Producing Porous Products

Patent No. 3,953,566

Born April 15, 1937

Inducted in 2006

Robert W. Gore invented a new form of polytetrafluoroethylene (PTFE) widely known by the GORE-TEX® brand name. This highly porous yet very strong material is chemically inert, functions within a wide range of temperatures, and is weatherproof. Valued by outdoor enthusiasts as durable, wind-resistant, waterproof and breathable, GORE-TEX® materials have also found applications in hundreds of medical, industrial, electrical and textile products.

Born in Salt Lake City, Utah, Gore pursued his undergraduate degree at the University of Delaware. As a college sophomore in 1957, he discovered a way to use PTFE tape to insulate wires and cables. In a 1969 experiment, Gore rapidly stretched heated rods of PTFE and created expanded PTFE, which was given the GORE-TEX® brand name.

Gore completed his graduate studies at the University of Minnesota, earning an M.S. and a Ph.D. in Chemical Engineering. He has spent his career at W. L. Gore & Associates, the company founded by his parents to develop PTFE-insulated cable based upon his first invention. In his tenure as president from 1976 to 2000, he guided the company from a wire and cable manufacturer into a diverse billion-dollar enterprise. He currently serves as chairman of the company's board of directors.

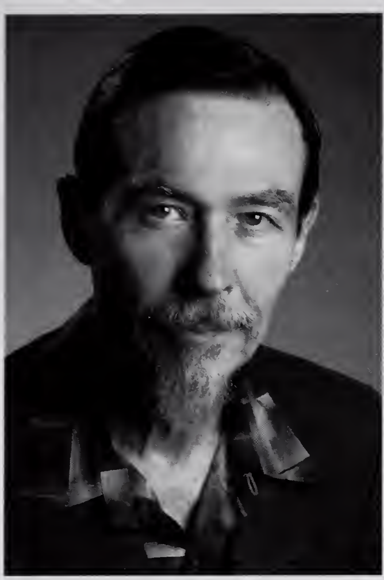

Photo credit: California Institute of Technology

Carver Mead

Processor which Sequences Externally of a Central Processor

Patent No. 3,959,774

Born May 1, 1934

Inducted in 2009

Carver Mead is an inventor, chip designer, entrepreneur, and university physicist. Mead helped to develop the standards and tools that permitted tens of thousands of transistors to be packaged on a single silicon chip, what is known as very large-scale integration (VLSI).

This advance, aided by Mead's 1980 textbook *Introduction to VLSI Design*, coauthored with Lynn Conway, came to be known as the Mead and Conway Revolution. College courses based on the text made use of the early Internet so that prototypes of students' chip designs could be rapidly fabricated by manufacturers across the country. Mead's VLSI methods permitted more people to more quickly design more powerful chips than ever before, invigorating the entire industry. Gordon Moore credits Mead with coining the term "Moore's Law" todescribe the notion that the number of transistors that can be packaged on an integrated circuit will double every two years, and Mead performed the physics calculations to prove it.

Born in Bakersfield, California, Mead has been associated with the California Institute of Technology since his undergraduate years. He joined the faculty in 1958 before receiving his Ph.D. in 1960. He has founded more than 20 companies, including Synaptics and Impinj.

Photo credit: ©The Nobel Foundation

Godfrey Newbold Hounsfield

Apparatus for Examining a Body by Means of Penetrating Radiation

Patent No. 3,965,357

Born August 28, 1919
Died August 12, 2004

Inducted in 2007

In the late 1960s, Godfrey Hounsfield began developing computer-assisted tomography, or CAT scanning, an improved form of diagnostic imaging. At Thorn EMI Ltd., he combined his understanding of electronics and radar to create three-dimensional images that illuminated the internal physiology of the human head.

Born in Newark, England, Hounsfield earned degrees from City and Guilds College of London and Faraday House Electrical Engineering College. He worked for England's Royal Air Force during World War II, where he served as an instructor in radar mechanics. After joining EMI in 1951, Hounsfield and his team set about to invent an X-ray scanner that rotated around a patient to image thin "slices" of the patient's head. The image slices were fed into a computer that produced a high-resolution, three-dimensional image with much greater detail than a conventional X-ray.

The first CAT scanner was installed for use in 1971. It provided physicians valuable diagnostic information without potentially hazardous exploratory surgery, revolutionizing medical care. Computer tomography was first used to take images of the skull to study diseases of the brain.

Credited with 72 patents, Hounsfield was awarded many honors for his technology, including the 1979 Nobel Prize.

Photo Credit: Courtesy of Defiance College

Harold McMaster

Glass Tempering System Including Oscillating Roller Furnace

Patent No. 3,994,711

Born July 20, 1916
Died August 25, 2003

Inducted in 2008

Harold McMaster achieved the centuries-old goal of producing high-quality strengthened, or tempered, glass. His invention is indispensable in modern skyscrapers and other applications where glass strength and safety are critical.

McMaster grew up on a tenant farm in northwest Ohio. Inventive at an early age, he built a threshing machine by age ten, and a car motor by 12. To develop his skills, he attended Defiance College on scholarship, and later transferred to Ohio State University where he earned B.A. and M.S. degrees in physics. After graduation in 1939, McMaster was hired as Libby-Owens-Ford Glass Company's first research physicist.

Early in his career, McMaster invented a rear-vision periscope for fighter aircraft and a method of applying electrical coatings to de-ice aircraft windows. In 1948, he founded Permaglass, Inc. where he commercialized glass tempering technology. In McMaster's tempering process, glass is heated and then rapidly cooled, leaving it stronger and able to be shaped. In addition, glass is safer after tempering because it breaks into small chunks with no sharp edges.

McMaster later developed other technologies. In all, he founded four companies and held over 100 patents in the fields of glass bending and tempering, solar energy, and rotary engines.

Photo credit: Courtesy of Merck & Co., Inc.

Maurice Ralph Hilleman

Mumps Vaccine and Its Preparation; Coupled H. Influenzae Type B Vaccine

Patent Nos. 3,555,149; 4,459,286

Born August 30, 1919
Died April 11, 2005

Inducted in 2007

Maurice Hilleman is recognized as the most prolific vaccine scientist of the 20th century, saving more lives than any other scientist. Most of his long career was at Merck, where he led the development of more than three dozen vaccines, including eight of the fourteen vaccines routinely recommended for children. Among these arevaccines for hepatitis A and B, Haemophilus influenzae type B (Hib), varicella, and the combined vaccine for measles, mumps, and rubella (MMR).

Hilleman made important contributions outside of vaccine development. He was the first to purify interferon, a discovery that launched new branches of molecular biology and immunology. He co-discovered adenoviruses and characterized the ongoing evolution of flu viruses, which forms the basis for global flu control strategies.

Hilleman was born in Miles City, Montana, and received his Ph.D. from the University of Chicago in 1944. He was awarded the National Medal of Science in 1988, and a Lifetime Achievement Award from the World Health Organization in 1996. His vaccines have virtually eliminated many of the once-common childhood diseases in developed countries.

Photo credit: Courtesy of Gordon Gould

Gordon Gould

Optically Pumped Laser Amplifiers; Light Amplifiers Employing Collisions to Produce a Population Inversion

Patent Nos. 4,053,845; 4,704,583

Born July 17, 1920
Died September 16, 2005

Inducted in 1991

Gordon Gould coined the word laser and patented optically pumped and discharge excited laser amplifiers now used in industrial, commercial, and medical applications of lasers. Born in New York City, Gould's ambition was to be an inventor. After majoring in physics at Union College, he went on to Yale University for graduate work in spectroscopy. He received an M.S. in physics in 1943 and for the rest of World War II worked on the Manhattan Project. After the war, he studied at Columbia University and laid the groundwork for his original concepts of laser technology.

Gould wrote down his first ideas for the laser in a notebook entitled "Some rough calculations on the feasibility of a LASER: Light Amplification by Stimulated Emission of Radiation," the first use of this acronym. However, because he misunderstood an attorney's advice, he didn't file for a patent until 1959, after other laser researchers had already filed. Since Gould's original patent application contained a number of different inventions it was put through a series of five separate interferences by the Patent Office.

Thus, it was not until 1977 that the first of Gould's basic laser patents was issued. These lasers are used in 80 percent of the industrial, commercial, and medical applications of lasers. Gould also holds patents on laser uses and fiber optic communications.

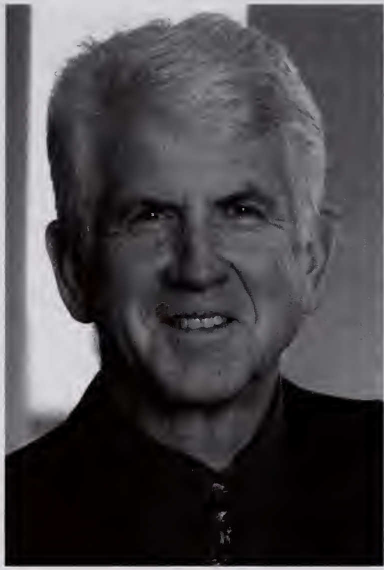

Photo credit: Brian Smith Photography

Robert M. Metcalfe

Multipoint Data Communication System with Collision Detection

Patent No. 4,063,220

Born April 7, 1946

Inducted in 2007

Robert Metcalfe invented, standardized, and commercialized Ethernet. Developed as a way to link the computers at Xerox's Palo Alto Research Center (PARC) to one another, Ethernet uses digital packets and distributed controls to transmit data over what would become the most widely used local area network, or LAN.

Metcalfe was born in Brooklyn, New York. He studied at the Massachusetts Institute of Technology, earning bachelor degrees in electrical engineering and industrial management before completing his M.S. and Ph.D. at Harvard University in 1973. Working with associates at PARC on some of the earliest personal computers, Metcalfe invented one of the first and now most widely deployed networking technologies, Ethernet. Today, over a quarter billion new Ethernet switch ports are shipped annually worldwide.

Metcalfe left Xerox in 1979 to found 3Com Corporation to manufacture LAN equipment with Ethernet technology, retiring in 1990. He is now with Polaris Venture Partners, fostering information technology start-ups. Metcalfe was awarded the National Medal of Technology in 2005 for his leadership in the invention, standardization, and commercialization of Ethernet.

Photo credit: Courtesy of Bristol-Myers Squibb

David Wayne Cushman

Proline Derivatives and Related Compounds

Patent No. 4,105,776

Born November 15, 1939
Died August 14, 2000

Inducted in 2007

David Cushman and Miguel Ondetti synthesized captopril, an oral drug that significantly reduces hypertension in more than eighty percent of users and has no side effects on the central or autonomic nervous systems. Captopril was the first in a life-saving class of drugs known as angiotensin converting enzyme, or ACE, inhibitors.

Cushman was born in Indianapolis, Indiana. After earning his Ph.D. from the University of Illinois, he joined Bristol-Myers Squibb, studying ACE inhibitors with Ondetti. Angiotensin was suspected of playing a role in regulating blood pressure, but the mechanism by which it did was not understood. Cushman and Ondetti developed the first quantitative analysis of ACE, purifying and characterizing the active enzyme. By 1970, they had isolated the amino-acid peptide that was an effective ACE inhibitor. After years of trying unsuccessfully to make the drug in pill form, they made a breakthrough in 1974, synthesizing captopril. The FDA approved captopril for medical use in 1982.

Originally approved for treatment of hypertension, ACE inhibitors have since been shown to be effective in treating patients with congestive heart failure, diabetes mellitus, chronic renal insufficiency, and atherosclerotic cardiovascular disease.

Photo credit: Courtesy of Bristol-Myers Squibb

Miguel Angel Ondetti

Proline Derivatives and Related Compounds

Born May 14, 1930
Died August 23, 2004

Inducted in 2007

Miguel Ondetti and David Cushman developed captopril, the first of a new class of drugs known as angiotensin converting enzyme (ACE) inhibitors. Highly effective in treating hypertension, captopril lowered blood pressure with fewer undesirable side effects than earlier treatments, increasing patients' quality of life and compliance.

Scientists had discovered that the venom of the Brazilian pit viper inhibited the production of angiotensin II, which causes narrowing of the blood vessels and increased blood pressure. While working at Bristol-Myers Squibb Company, Ondetti and Cushman identified, purified, and synthesized the key substance. After years of trying to make the drug in pill form, they made a breakthrough in 1974, synthesizing captopril.

Captopril was the first medical treatment to establish angiotensin's vital role in hypertension, unveiling a new field of medical research, ACE inhibition. Captopril has been found to significantly reduce death rates in patients with congestive heart failure and to be effective in postponing kidney failure in diabetics.

Born in Buenos Aires, Argentina, Ondetti earned his Ph.D. from the Universidad de Buenos Aires in 1957. During his 34-year career at Bristol-Myers Squibb, he earned more than 100 patents and was awarded the Perkin Medal in 1991.

Photo credit: Page One Photography

Peter Mansfield

Nuclear Magnetic Resonance Apparatus and Methods

Patent No. 4,115,730

Born October 9, 1933

Inducted in 2007

Peter Mansfield invented echo-planar imaging (EPI), the first fast magnetic resonance imaging (MRI) technique. EPI provides precise images of the brain and other internal organs, replacing invasive methods of examination and reducing the risk and discomfort for many patients. More than 60 million cases are evaluated with MRI each year.

Working at the University of Nottingham in England, Mansfield proposed a method for creating clearer images using a unique field gradient scheme and developed mathematical techniques for capturing, analyzing, and processing MR signals more efficiently. This led him to conceive EPI, which produced quicker, higher quality MR images. Less sensitive to motion than conventional MRI, EPI allows imaging of rapidly changing physiologic processes such as a beating heart or blood flow. Consequently, the EPI technique is used to watch brain activity and cardiac function in real time. Its superior imaging techniques have dramatically improved diagnostics in many diseases.

Born in England, Mansfield earned his Ph.D. from the University of London's Queen Mary College in 1962. He was knighted in 1993 and received the Nobel Prize in Physiology or Medicine for his contributions to magnetic resonance imaging in 2003.

Photo credit: CRAY Research

Seymour Cray

Computer Vector Register Processing

Patent No. 4,128,880

Born September 28, 1925
Died October 5, 1996

Inducted in 1997

Seymour Cray unveiled the CRAY-1 in 1976, considered the first supercomputer. Born in Chippewa Falls, Wisconsin, Cray was interested in chemistry and radio as a child. After a brief service during World War II, he went to the University of Minnesota where he studied engineering. In 1951 he joined Engineering Research Associates which was developing computers for the Navy. Later he co-founded Control Data Corporation, and in 1972 he founded CRAY Research.

The CRAY-2, his second supercomputer, came in 1985. The amount of silicon chips used in CRAY-2 caused a problem because they overheated so intensely during use. By immersing CRAY-2 in a cooling bath of liquid fluorocarbon, Cray kept the chips from melting. In 1988 he founded Cray Computer in Colorado Springs where he worked on CRAY-3.

Shortly before his death in 1996, he founded SRC Computers, Inc. Cray's theory for success with the CRAY-3 was to substitute revolutionary new gallium arsenide integrated circuits for the traditional silicon ones.

Photo credit: Courtesy of Steven Sasson

Steven Sasson

Electronic Still Camera

Patent No. 4,131,919

Born July 4, 1950

Inducted in 2011

In 1974, Kodak supervisor Gareth Lloyd asked electrical engineer Steve Sasson to investigate whether charge-coupled devices could be used to create an image sensor for a camera. After a year in the laboratory, Sasson created a device that captured an image, converted it to an electronic signal, digitized the signal, and stored the image—the first digital camera.

An early adopter of digital imaging technology was the newspaper industry. In 1994, Kodak developed one of the first commercially-available digital cameras, the AP NC 2000, in cooperation with the Associated Press and Nikon. The first consumer digital camera to incorporate an LCD screen on the back was the Casio QV-10 in 1995, which retailed for around $650 and had 2MB of memory.

Today, consumers can choose from a wide array of cameras, from less than $100 to thousands of dollars. In 2008, 73% of Americans owned a digital camera and 34 million digital cameras were sold in the U.S., generating $7 billion in revenue. Virtually all of today's digital cameras rely on the same structure that Sasson invented in 1975.

Raised in Brooklyn, Sasson attended Rensselaer Polytechnic Institute, receiving his B.S. and M.S. He joined Kodak in 1973 and remains there today. Most recently, he works with Kodak's Intellectual Property Transactions group.

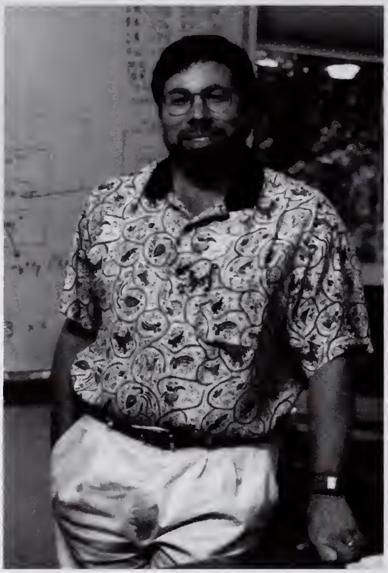

Photo credit: Unuson Corp.

Steve Wozniak

Microcomputer for Use with Video Display

Patent No. 4,136,359

Born August 11, 1950

Inducted in 2000

Steve Wozniak created the world's first personal computer, introducing it as the Apple II in 1977. He improved upon previous attempts by providing more memory, a keyboard, a disk drive, and color graphics. The Apple II brought success to Apple Computer, the company co-founded by Wozniak in 1976. Featuring a floppy disk and a $1,300 price tag, the Apple II was integral in launching the personal computer industry. In just six years, Apple Computer grew to a $500 million a year company.

Born in San Jose, California, Wozniak has lived his whole life in the Silicon Valley area. Although he attended college after graduating high school, he dropped out to work and build computers. However, he returned to school and in 1986, earned a B.S. in electrical engineering and computer science from Berkeley.

Wozniak left Apple Computer in 1985. In the early 1980s, he formed Unuson (Unite Us in Song) and staged his U.S. Music Festivals. His strong belief in education has prompted him to donate computers to schools in the U.S. and in the former USSR. He has also donated servers, Internet access for students, and computer training for teachers. His belief in hands-on learning and encouraging creativity in children continues to be his driving force.

Photo credit: Children's Hospital Boston Archives

M. Judah Folkman

Systems for the Controlled Release of Macromolecules

Patent No. 4,164,560

Born February 4, 1933
Died January 14, 2008

Inducted in 2010

Physician and researcher Judah Folkman introduced the idea that tumors could not grow beyond a certain size without having new blood vessels to feed them.

As a surgical resident conducting research in the 1960s, Folkman found that when studying mouse tumors in the lab, small new blood vessels would form, supplying the tumors. He began to think that tumor growth and angiogenesis, the formation of new blood vessels, were related, eventually claiming that angiogenesis was crucial to tumor development and growth, and that limiting the flow of blood would keep tumors in check. Consequently, Folkman wondered if retarding angiogenesis could be a way to treat cancer.

His basic ideas were applied to cancer drug research, resulting in successful cancer drugs such as Avastin. Today, over 10 angiogenesis inhibitors have been approved by the FDA, with over a million patients worldwide receiving antiangiogenic therapy.

Folkman was born in Cleveland, Ohio, attending Ohio State University for his B.A. and Harvard Medical School for his M.D. He was well-respected at the institutions where he worked, including Children's Hospital Boston and Harvard Medical School. The author of over 380 papers, Folkman was the recipient of many awards. His research has also allowed for breakthrough treatments for macular degeneration.

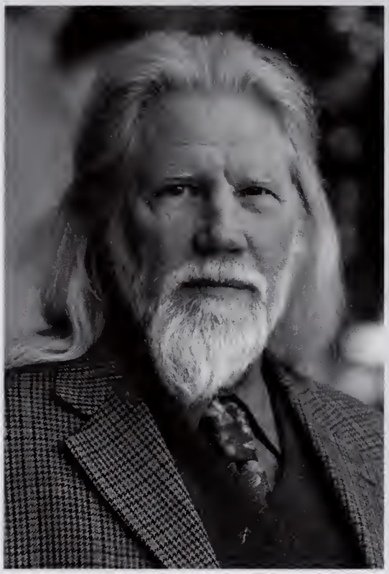

Photo credit: Courtesy of Stanford University

Whitfield Diffie

Cryptographic Apparatus and Method

Patent No. 4,200,770

Born June 5, 1944

Inducted in 2011

In 1976, Whitfield Diffie, Martin Hellman, and Ralph Merkle developed public key cryptography (PKC), an innovative new method for securing electronic communications. PKC provides security on the otherwise highly insecure Internet, making it vital to such areas as e-commerce.

In traditional cryptography, the same key is used both to encrypt and decrypt a message. To preserve secrecy, keys must be exchanged via couriers or other secure means. With PKC, each individual has his own unique key pair consisting of a public key and a private key. Only the public key needs to be exchanged, eliminating the need for couriers. If a person's public key is used to encrypt a message, then only his corresponding private key can decrypt it, providing privacy. Likewise, if his private key is used to sign (encrypt) a message, the corresponding public key can authenticate (decrypt) the message.

A native of New York City, Diffie received his B.S. from MIT. After many years with Sun Microsystems, in 2010 Diffie joined the Internet Corporation for Assigned Names and Numbers (ICANN) as Vice President for Information Security and Cryptography.

Photo credit: Courtesy of Martin Hellman

Martin Hellman

Cryptographic Apparatus and Method

Patent No. 4,200,770

Born October 2, 1945

Inducted in 2011

In 1976, Whitfield Diffie, Martin Hellman, and Ralph Merkle developed public key cryptography (PKC), an innovative new method for securing electronic communications. PKC provides security on the otherwise highly insecure Internet, making it vital to such areas as e-commerce.

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Hellman is professor emeritus at Stanford, and his current focus is the application of risk analysis to nuclear deterrence. Born in New York City, he received his B.E. from New York University and his M.S. and Ph.D. from Stanford.

Photo credit: Courtesy of Ralph Merkle

Ralph Merkle

Cryptographic Apparatus and Method

Patent No. 4,200,770

Born February 2, 1952

Inducted in 2011

Ralph Merkle realized public key cryptography (PKC) was possible in 1974 as an undergraduate at U.C. Berkeley. He worked alone until he joined forces with Whitfield Diffie and Martin Hellman in 1976. This fruitful collaboration saw the development of an innovative method for securing electronic communications.

In traditional cryptography the same key is used both to encrypt and decrypt a message. To preserve secrecy, keys must be exchanged via couriers or other secure means. With PKC, each individual has his own unique key pair consisting of a public key and a private key. Only the public key needs to be exchanged, eliminating the need for couriers. If a person's public key is used to encrypt a message, then only his corresponding private key can decrypt it, providing privacy. Likewise, if his private key is used to sign (encrypt) a message, the corresponding public key can authenticate (decrypt) the message.

Merkle is a Senior Research Fellow with the Institute for Molecular Manufacturing, is on the faculty of Singularity University, co-founded the Nanofactory Collaboration and is an Alcor Director. Born and raised in California, he first attended the University of California, Berkeley and then went on to Stanford for his Ph.D.

Photo credit: Courtesy of the Mirowski Family

Michel Mirowski

Method and Apparatus for Monitoring Heart Activity, Detecting Abnormalities, and Cardioverting a Malfunctioning Heart

Patent No. 4,202,340

Born October 14, 1924
Died March 26, 1990

Inducted in 2002

Michel Mirowski conceived of the automatic implantable cardioverter defibrillator (ICD) in the 1960s after his mentor died of a heart arrhythmia.

Facing formidable opposition from the medical community, Mirowski led a team that designed and tested the first ICD, which was also the first alternative to drugs and surgery. The first human implant occurred in 1980. The device was originally the size of a deck of cards and weighed nine ounces. Since then, ICDs have gotten smaller, but the technology remains the same. The device has saved hundreds of thousands of patients worldwide.

Born in Warsaw, Poland, Mirowski left his home at age fourteen to escape the Nazis. He was the only member of his family to survive the Holocaust. After the war, he went to France where he attended medical school in Lyon. He completed his residency in Israel, at Tel Hashomer Hospital, and cardiology fellowships at the Johns Hopkins Hospital in Baltimore and the Institute of Cardiology in Mexico City. He returned to Israel in 1962 to become the Chief of Cardiology at Asaf Horofeh Hospital.

In 1968, Mirowski became the first Director of the Coronary Care Unit at Sinai Hospital of Baltimore, where he conducted his research on the ICD.

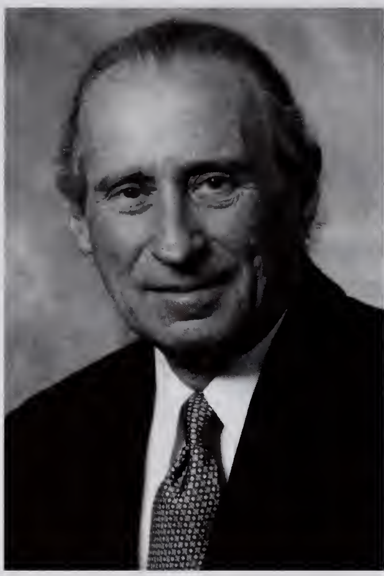

Photo credit: Jerry Easterson Photography

Morton Mower

Method and Apparatus for Monitoring Heart Activity, Detecting Abnormalities, and Cardioverting a Malfunctioning Heart

Patent No. 4,202,340

Born January 31, 1933

Inducted in 2002

Morton Mower co-invented the automatic implantable cardioverter defibrillator, now implanted in well over 300,000 people. The ICD monitors and corrects abnormal heart rhythms and is 99% effective in treating sudden cardiac arrest.

Normally, a natural pacemaker within the heart stimulates it to contract, producing a heartbeat. Ventricular fibrillation occurs when impulses from the heart's ventricles signal the heart to beat abnormally, causing very little blood to be pumped through the heart to the brain and body, which can result in sudden cardiac death. One reason the ICD is successful is because it treats ventricular fibrillation within seconds, preventing sudden cardiac death.

Mower, born in Baltimore, was a 1955 graduate of the Johns Hopkins University and a 1959 graduate of the University of Maryland School of Medicine. He served in the U.S. Army, then joined Sinai Hospital where he served his residency and a fellowship in cardiology. Throughout his career, he has had a private practice and served as Chief of Cardiology at Sinai, and as Vice President of Medical Science at Cardiac Pacemakers, Inc. In 1995, he became a senior consultant of the CPI division of Guidant Corporation and retired from CPI Guidant in 1996 to become chairman and CEO of Mower Research Associates.

Photo credit: Courtesy of Invent Now, Inc.

M. Stephen Heilman

Method and Apparatus for Monitoring Heart Activity, Detecting Abnormalities, and Cardioverting a Malfunctioning Heart

Patent No. 4,202,340

Born December 25, 1933

Inducted in 2002

Stephen Heilman co-invented the automatic implantable cardioverter defibrillator, a device that detects and corrects heart arrhythmias in patients who would otherwise die from sudden cardiac death. The ICD has greatly reduced the sudden cardiac death rate and generates over two billion dollars a year in business.

Ventricular fibrillation occurs when many different impulses from the ventricles signal the heart to beat. The heartbeat can rise to over 300 beats a minute, and virtually no blood is pumped from the heart to the body. External defibrillators shock the heart into a more normal rhythm, but this requires human aid and equipment availability. If the ICD senses a ventricular fibrillation, it automatically delivers an internal shock to the heart to correct the abnormal rhythm.

Born in Tarentum, Pennsylvania, Heilman earned his B.A. in 1955 and his medical degree in 1959 from the University of Pennsylvania. He served in the U.S. Air Force before founding Medrad in 1964, a company that specializes in medical imaging devices. Since 1986, he has served as founder, chairman, and CEO of VASCOR, Inc., established to develop a ventricular assist device and Lifecor, Inc., which has developed and received FDA approval for the world's first patient-worn automatic external defibrillator. Heilman holds over 30 U.S. patents.

Photo credit: Courtesy of Invent Now, Inc.

Alois A. Langer

Method and Apparatus for Monitoring Heart Activity, Detecting Abnormalities, and Cardioverting a Malfunctioning Heart

Patent No. 4,202,340

Born February 24, 1945

Inducted in 2002

Alois A. Langer was the engineer on the medical team that invented the first automatic implantable cardioverter defibrillator (ICD). This device is implanted in the human body and automatically corrects potentially fatal irregular heartbeat patterns called arrhythmias. It has revolutionized the way doctors treat heart patients, has been implanted in a U.S. vice president, and has saved thousands of lives.

Born in Pittsburgh, Pennsylvania, Langer graduated from the Massachusetts Institute of Technology in 1967 with a degree in electrical engineering and later from Carnegie Mellon University with a Ph.D. in electrical engineering/biotechnology. His first position was as project engineer for Medrad's ICD development project. He specified and designed most of the miniaturized electronic circuits in the defibrillator and designed the mechanical package. These efforts resulted in many additional patents for ICDs.

Langer remains active in diagnosis and treatment of arrhythmias, having founded Cardiac Telecom Corporation, a pioneer in providing in-hospital grade cardiac surveillance over telephones for patients at home through its Telemetry@Home service. Heartbeat problems are detected and called in automatically, viewed at a remote receiving center, and then timely treatment can be initiated.

Photo credit: ©National Inventors Hall of Fame

Stanley N. Cohen

Process for Producing Biologically Functional Molecular Chimeras

Patent No. 4,237,224

Born February 17, 1935

Inducted in 2001

In 1973, Stan Cohen and Herb Boyer worked together to understand how genes work and ended up proving that DNA cloning was feasible. Their experiments showed that DNA molecules containing non-native genes were functional and capable of being propagated in living cells. This work has laid the foundation for much of modern biology. Cohen, at Stanford University, and Boyer, at the University of California, San Francisco, first discussed collaborating at a conference both were attending in 1972. Back home, they combined and transplanted genes between bacteria and from animal cells to bacteria. Their work was successful, and the terms DNA cloning and recombinant DNA entered the vocabulary. The invention of genetic engineering also helped launch the multi-billion dollar biotechnology industry. Human growth hormones, interferon, insulin, and other human gene products having specific medical uses are available only because they can be made using DNA cloning methods.

Cohen was born in Perth Amboy, New Jersey. He graduated from Rutgers University in 1956 and from the University of Pennsylvania School of Medicine in 1960. He joined the faculty of the Stanford University School of Medicine in 1968, where he remains today. His many awards include the National Medal of Science and the National Medal of Technology.

Photo credit: Genentech, Inc.

Herbert W. Boyer

Process for Producing Biologically Functional Molecular Chimeras

Patent No. 4,237,224

Born July 10, 1936

Inducted in 2001

Herb Boyer was with the University of California, San Francisco when he began investigating DNA with Stan Cohen. Their experiments marked the beginning of genetic engineering and launched the multi-billion dollar biotechnology industry. By early 1973, Boyer and Cohen determined that they were able to add genes from an organism to a simple cell; the genes would then replicate in the cell. Their recombinant DNA patents generated over $250 million in royalties before expiring. Recombinant DNA technology is considered the most significant achievement in molecular biology since Watson & Crick's work in 1953. After working with Cohen, Boyer joined forces with venture capitalist Robert Swanson to create the biotechnology firm Genentech, Inc. Since its founding in 1976, Genentech has produced a number of firsts such as genetically engineered human insulin. Genetically altered crops are also being researched to deal with global food supply issues.

Boyer was born in Pittsburgh, grew up in western Pennsylvania, and attended St. Vincent College in Latrobe. He completed graduate work at the University of Pittsburgh and post-graduate work at Yale. In 1966, he joined the University of California, San Francisco, staying until 1991. Boyer has been honored with many awards, including the National Medal of Science and the National Medal of Technology.

Photo credit: Courtesy of UOP LLC

Edith Flanigen

Crystalline Metallophosphate Compositions

Patent No. 4,310,440

Born January 28, 1929

Inducted in 2004

In 1956, Edith Flanigen began working on the emerging technology of "molecular sieves," crystalline microporous structures with large internal void volumes and molecular-sized pores. These compounds can be used to purify and separate complex mixtures and catalyze or speed the rate of hydrocarbon reactions, and have widespread application in the petroleum refining and petrochemical industries. During her 42-year career at Union Carbide and UOP, Flanigen invented or co-invented over 200 novel synthetic materials, and made substantial contributions to the product development of zeolite Y, an aluminosilicate sieve used to make oil refining more efficient, cleaner and safer. Her work with molecular sieves also led to innovative applications in water purification and environmental cleanup. Additionally, Flanigen invented a hydrothermal emerald synthesis process and pioneered the use of mid-infrared spectroscopy for analyzing zeolite structures.

Edith Flanigen was born in Buffalo, New York. She received a B.A. from D'Youville College and an M.S. in inorganic-physical chemistry from Syracuse University in 1952. Flanigen is the holder of 108 U.S. patents. In 1991, she became the first woman to be awarded the Perkin Medal, America's top honor in applied chemistry.

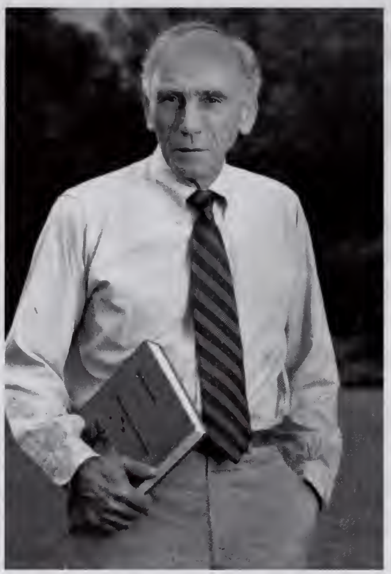

Photo credit: Eli Lilly & Co.

Bryan B. Molloy

Aryloxyphenylpropylamines

Patent No. 4,314,081

Born March 30, 1939
Died May 8, 2004

Inducted in 1999

Bryan Molloy and Klaus Schmiegel co-invented a class of aryloxyphenylpropylamines, which includes the active ingredient in Prozac®, the most widely used antidepressant, which has been prescribed for over 35 million people. Introduced by Eli Lilly & Co. in the U.S. in 1988, Prozac represented a new class of antidepressants called selective serotonin reuptake inhibitors. Prozac treats depression with fewer side effects than previous antidepressants.

The search by Molloy and the chemistry team at Eli Lilly for an effective antidepressant led them to synthesize many new compounds. After many failures, they tested a group of compounds called aryloxyphenylpropylamines. One of these compounds, fluoxetine hydrochloride, was found to be highly selective, affecting only the neurotransmitter serotonin. Years of development and testing finally led to approval of fluoxetine hydrochloride for marketing.

Molloy was born in Scotland, where he grew up and attended school. After he graduated with his B.S. and Ph.D. in chemistry from the University of St. Andrews, Molloy did postdoctoral work in the U.S. and England before joining Eli Lilly in 1966 as a senior organic chemist. Molloy published over 100 papers and acquired over 30 patents while at Eli Lilly. He became a Lilly Research Fellow in 1983.

Photo credit: Eli Lilly & Co.

Klaus K. Schmiegel

Aryloxyphenylpropylamines

Patent No. 4,314,081

Born June 28, 1939

Inducted in 1999

Klaus Schmiegel and Bryan Molloy co-invented a class of aryloxyphenylpropylamines which includes the compound fluoxetine hydrochloride. Fluoxetine hydrochloride is the active ingredient in Prozac®, the widely successful antidepressant.

Since its introduction in the U.S. in 1988, Prozac has revolutionized the treatment of depression. It was the first commercially available SSRI, or selective serotonin reuptake inhibitor. Serotonin is a neurotransmitter, a chemical that carries messages between nerve cells; it is secreted by one cell and picked up by receptors on another. Once the message is received, a neurotransmitter is retrieved back into the cell that secreted it in a process known as reuptake. Prozac is believed to inhibit the reuptake of serotonin in most patients suffering from depression.

Schmiegel was born in Chemnitz, Germany, and in 1951 immigrated to Michigan. He received his B.S. in chemistry from the University of Michigan, an A.M. in organic chemistry from Dartmouth College, and a Ph.D. in organic chemistry from Stanford University. He joined Eli Lilly in 1968 as a senior organic chemist, remaining there until his retirement in 1993. During his career, he received 18 patents in areas relating to the synthesis of compounds.

Photo credit: IBM Zurich Research Laboratory

Gerd Karl Binnig

Scanning Tunneling Microscope

Patent No. 4,343,993

Born July 20, 1947

Inducted in 1994

Gerd Karl Binnig and Heinrich Rohrer based their scanning tunneling microscope (STM) on a principle of quantum mechanics which allows the surface of a sample to be viewed atom by atom, magnified 100 million times. The STM consists of two parts, suspended from springs, within a stainless steel frame; the innermost part contains the microscope mechanism. A needle-sharp stylus is kept at a critically controlled constant distance from the surface of a sample. The electrons at the probe's tip disappear and reappear on the sample's surface, creating a minute electrical current (tunneling). To get high-resolution images of the structures, the microscope is shielded with copper plates and magnets from small vibrations.

It was introduced in 1981, and by 1989, there was a large growth in the number of STM's because of the number of applications, such as in the fields of silicon wafers, disks, and optical products manufacturing.

Binnig was born in Frankfurt, West Germany, and received his Ph.D. from Johann Wolfgang Goethe University of Frankfurt in 1978. The same year, he joined the IBM Zurich Division's Research Laboratory and began work on the scanning tunneling microscope. In 1986, Binnig and Rohrer were awarded the Nobel Prize for Physics.

Photo credit: IBM Zurich Research Center

Heinrich Rohrer

Scanning Tunneling Microscope

Patent No. 4,343,993

Born June 6, 1933

Inducted in 1994

Ever since the first microscope, scientists have sought for improved ways to explore the microscopic world. Optical systems were limited by the wavelength of light. Later, electron microscopes achieved much higher resolution by taking advantage of the shorter wavelength of electrons in forming images.

The most recent revolution came with Heinrich Rohrer and Gerd Karl Binnig's scanning tunneling microscope (STM), in 1981, which provided the first images of individual atoms on the surfaces of materials. The STM can image atomic details as tiny as 1/25th the diameter of a typical atom, which corresponds to a resolution several orders of magnitude better than the best electron microscope. The STM's significance was quickly recognized, and it is used in fields as diverse as semiconductor science, metallurgy, and molecular biology.

In 1986, Rohrer and Binnig were awarded the Nobel Prize for Physics. They began their work at the IBM Zurich Division's Research Laboratory in 1978. Rohrer, born in Switzerland, received his degree from Eidenossiche Technische Hockschule in Zurich in 1960 and joined IBM in 1963.

Photo credit: Donna Coveney/MIT News Service

Robert S. Langer, Jr.

Systems for the Controlled Release of Macromolecules; High Molecular Weight Polyanhydride and Preparation Thereof

Patent Nos. 4,391,797; 4,757, 128

Born August 29, 1948

Inducted in 2006

Robert Langer revolutionized biomedical technology through the development of a controlled drug delivery system.

Langer was born in Albany, New York. After earning his doctorate at MIT in 1974, he began developing a system for delivering inhibitors to cancerous tumors. Langer discovered a way to control the delivery of large molecule drugs by using both nondegradable and biodegradable polymers to engineer synthetic materials that allow for precisely timed chemical release.

Langer made numerous improvements on his controlled delivery system. Designing a chemotherapy wafer for the treatment of brain cancer, he was able to administer slow releasing cancer-killing medication directly where the cancerous tumor had been removed. He also pioneered a variety of remotely controlled drug delivery systems that vary the amount of drug released through electric impulse, ultrasound, and magnetic field.

Holder of over 300 U.S. and foreign patents, Langer's controlled drug delivery innovations are the basis of a multibillion dollar industry in the United States. An Institute Professor at the Massachusetts Institute of Technology, Langer was recognized in 1998 with the Lemelson-MIT Prize, being cited as one of history's most prolific inventors in medicine.

Photo Credit: Pfizer

Ken Richardson

Antifungal 1, 3-Bis-Triazolyl-2-Propanol Derivative

Patent No. 4,404,216

Born November 26, 1939

Inducted in 2008

Ken Richardson is credited with discovering one of the most important breakthroughs in the history of anti-fungal research, fluconazole (Diflucan®), the world's leading antifungal drug for human use. In the U.S., fluconazole was recognized as being so important that the FDA gave it fast-track treatment, approving it for use in only nine months. It has saved the lives of millions around the world by treating transplant recipients, burn victims, chemotherapy patients, AIDS patients, and others with weakened immune systems that make them targets of deadly fungal diseases.

Born in the British Midlands near Nottingham, Richardson left school at the age of sixteen to become a laboratory assistant during the day. By attending evening classes, he earned his first degree in chemistry from Trent Polytechnic in 1965 and then earned his Ph.D. from the University of Nottingham in 1968. He later worked with Nobel laureate chemist R.B. Woodward at Harvard and went on to become a research scientist for Pfizer where he led the research team that discovered fluconazole.

Richardson has received various awards for his discovery, including the UK Society for Drug Research Award for Drug Discovery and the Pharmaceutical Manufacturers of America Discoverers Award. He was also named an Officer of the Order of the British Empire by Queen Elizabeth II.

Photo credit: Courtesy of Paul Baran

Paul Baran

Packetized Ensemble Modem

Patent No. 4,438,511

Born April 29, 1926
Died March 26, 2011

Inducted in 2007

Paul Baran developed a fundamental concept behind today's advanced communications networking systems: digital packet switching.

Baran was born in Grodno, Poland and came to the U.S. at the age of two. In 1949, he earned his B.S. in electrical engineering from Drexel University and his M.S. from the University of California at Los Angeles in 1959. Following his graduation from UCLA, Baran was at the RAND Corporation where he designed a communication network to survive a first strike from the Soviet Union during the Cold War. He based his network on a mesh network able to reconfigure itself to bypass non-working areas. To create this totally decentralized network, Baran divided the communications stream into message blocks, or "packets," sent along various paths to eventually be rejoined into a whole at their destination.

The digital packet concept is a paradigm shift from the circuit switched communications networks of the past. Packet switching enables the construction of digital networks with greater flexibility, reliability, robustness, and lower cost than circuit switching and now has become the new standard way of building communications networks. Baran held 31 patents for his work on several new communications technologies in part based upon the concept of packets.

Photo Credit: Bose Corporation

Amar G. Bose

Feedback Control

Patent No. 4,494,074

Born November 2, 1929

Inducted in 2008

A pioneer in modern acoustics, Dr. Amar Bose is Founder, Chairman and Technical Director of the internationally-recognized audio company that bears his name.

Raised just outside Philadelphia, Bose began his career at the age of 13, repairing radios in his basement during WWII. His passion for technology continued at MIT, where he earned Bachelor, Master and Doctoral degrees in Electrical Engineering. In 1956, Bose was asked to join the faculty at MIT, where he taught until 2001.

His research at MIT led to the development of new, patented technologies. With those patents, he founded Bose Corporation in 1964. He has achieved worldwide acclaim with the introduction of groundbreaking products, including the 901® Direct/Reflecting speaker system, customized sound systems for automobiles, and active noise-reducing headphones. Under his leadership, 100 percent of profits are reinvested back into the company, enabling advancements in non-audio areas. In 2004, after 25 years of research, he introduced a revolutionary suspension system that combines superior comfort and control in the same vehicle.

Bose has done extensive work for the Armed Forces and NASA. He was named Inventor of the Year in 1987 by the Intellectual Property Owners Association and holds numerous patents in the fields of acoustics, electronics, nonlinear systems, and communication theory.

Photo credit: Courtesy of IBM

Mark Dean

Microcomputer System with Bus Control Means for Peripheral Processing Devices

Patent No. 4,528,626

Born March 2, 1957

Inducted in 1997

Mark Dean and his co-inventor Dennis Moeller created a microcomputer system with bus control means for peripheral processing devices. Their invention paved the way for the growth in the Information Technology industry by allowing the use of plug-in subsystems and peripherals like disk drives, video gear, speakers, and scanners.

Born in Jefferson City, Tennessee, Dean received his undergraduate degree in Electrical Engineering from the University of Tennessee, his master's in electrical engineering from Florida Atlantic University and his Ph.D. in Electrical Engineering from Stanford University. Early in his career at IBM, Dean was chief engineer working with IBM personal computers. The IBM PS/2 Models 70 and 80 and the Color Graphics Adapter are among his early work; he holds three of IBM's original nine PC patents.

Currently, Dean is Vice President of Technical Strategy and Worldwide Operations. Dean was named an IBM fellow in 1995 and in 1997 received the Black Engineer of the Year President's Award. Dean holds more than twenty patents.

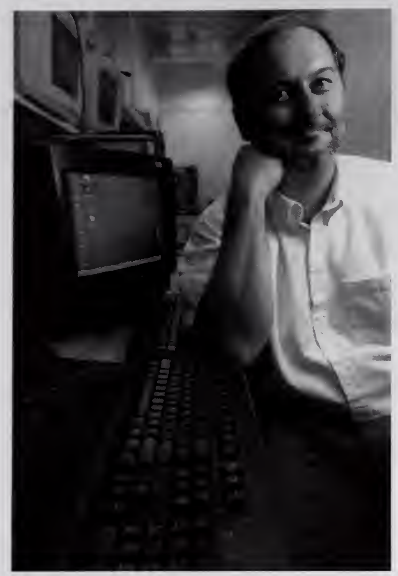

Photo credit: Courtesy of IBM

Dennis L. Moeller

Microcomputer System with Bus Control Means for Peripheral Processing Devices

Patent No. 4,528,626

Born April 28, 1950

Inducted in 1997

Dennis Moeller and Mark Dean together created a microcomputer system with bus control means for peripheral processing devices. The bus serves as the backbone of the computer by connecting its brain—the central processing unit—with its limbs, the keyboard, monitor, printer, as well as any other devices. Today, this technology is called the Industry Standard Architecture (ISA) expansion bus.

Born in St. Louis, Missouri, Moeller received his B.S. and his M.S. in Electrical Engineering at the University of Missouri in Columbia. In 1974 he began working for IBM on semiconductor manufacturing. Two years later, he started working on the Series 1 mini-computer printer family, and from 1982 through 1984, he worked on the PCAT project team. Since 1984 he has worked on numerous PC-related research and development projects.

Currently he is a senior technical staff member in the IBM Consumer Division which produces the Aptiva line of home computers. He holds 25 patents in PC system designs and PC printers.


Photo credit: Paul Nestor

Kary B. Mullis

Process for Amplifying Nucleic Acid Sequences

Patent No. 4,683,202

Born December 28, 1944

Inducted in 1998

The polymerase chain reaction, which was devised by Kary Mullis, has revolutionized DNA technology. It has had a major impact on molecular biology, medicine, forensics, molecular paleontology, and many related fields.

PCR amplifies specific DNA sequences from very small amounts of complex genetic material. The amplification produces an almost unlimited number of highly purified DNA molecules suitable for analysis or manipulation. PCR has allowed screening for genetic and infectious diseases. Analysis of DNAs from different populations, including DNA from extinct species, has allowed the reconstruction of phylogenetic trees including primates and humans. PCR is essential to forensics and paternity testing.

Mullis was born in Lenoir, North Carolina and grew up in Columbia, South Carolina. He received a B.S. from Georgia Tech and a Ph.D. from the University of California at Berkeley. While working for Cetus Corporation, he invented PCR, which immediately spread to laboratories around the world where DNA chemistry was performed. PCR technology has grown into a several billion dollar a year industry. For his work, Mullis received the Japan Prize and the Nobel Prize for Chemistry, both in 1993.

Photo credit: Institute of Human Virology

Robert Gallo

Human Immunodeficiency Viruses Associated with Acquired Immune Deficiency Syndrome (AIDS), A Diagnostic Method for AIDS and Pre-AIDS, and a Kit Therefor

Patent No. 4,708,818

Born March 23, 1937

Inducted in 2004

Robert Gallo played a key role in identifying the cause and detection of one of the most serious medical scourges of the 20th century. Gallo, a veteran of years of research on cancer, helped determine that the Human Immunodeficiency Virus (HIV) caused the fatal condition Acquired Immune Deficiency Syndrome, commonly called AIDS. Pursuing research also done by French scientist Luc Montagnier, Gallo helped develop a laboratory test to detect HIV; this test proved essential to diagnose the virus and to protect the world's blood supply from the growing threat of HIV contamination.

Recognized as a pioneering influence in the field of virology, Gallo's other contributions include discoveries that led to diagnostic and therapeutic advances in cancer and several viral diseases.

Born in Waterbury, Connecticut, Gallo earned a B.S. in biology from Providence College in 1959. He earned his M.D. from Jefferson Medical College in Philadelphia in 1963, then did an internship and residency in medicine at the University of Chicago before becoming a cancer researcher for the National Cancer Institute. Among many other awards, Gallo is a two-time winner of the prestigious Albert Lasker Award and was the most cited scientist of the decade of the 1980s.

Photo credit: ©Custom Medical Stock Photo

Luc Montagnier

Human Immunodeficiency Viruses Associated with Acquired Immune Deficiency Syndrome (AIDS), A Diagnostic Method for AIDS and Pre-AIDS, and a Kit Therefor

Patent No. 4,708,818

Born August 18, 1932

Inducted in 2004

Dr. Luc Montagnier is best known for his 1983 discovery of the Human Immunodeficiency Virus (HIV), which has been identified as the cause of AIDS. This discovery led directly to the development of a test for detecting the presence of HIV in blood samples.

In the years before the onset of the AIDS epidemic, Montagnier's significant discoveries concerning the nature of viruses contributed to the understanding of how viruses can alter the genetic information of host organisms, facilitating cancer research. His investigation of interferon, one of the body's defenses against viruses, also opened avenues for medical cures for viral diseases.

Montagnier was born in Chabris, France. He received his license of sciences from the University of Paris in 1955, earning his doctorate in 1960. Montagnier became research director of the Centre National de la Recherche Scientifique (CNRS) in 1974 and in 1985 professor at the Pasteur Institute.

He is the co-founder of the World Foundation for AIDS Research and Prevention and co-directs the Program for International Viral Collaboration. He has received more than 20 major awards, including the Commandeur de la Legion d'Honneur, the Lasker Prize, the Gairdner Prize, and in 2008 the Nobel Prize in Physiology or Medicine.

Photo credit: Landers Photography

Julio C. Palmaz

Expandable Intraluminal Graft, and Method and Apparatus for Implanting an Expandable Intraluminal Graft

Patent No. 4,733,665

Born December 13, 1945

Inducted in 2006

Starting with a discarded piece of metal from the floor of his garage, Julio Palmaz invented the first commercially-successful intravascular stent, the Palmaz Stent®. His stent revolutionized cardiac care, with more than a million people undergoing coronary artery stenting annually to repair clogged arteries.

The stent – an open mesh tube that once inserted expands the vessel, holding it open to restore normal blood flow – has had a major impact on the management of atherosclerotic arterial disease. Specifically, it has revolutionized the management of coronary artery disease. Many coronary by-pass surgeries that would have once been inevitable can now be avoided through stenting.

Born in Argentina, Palmaz studied at the National University of La Plata in Argentina, earning his medical degree in 1971. He practiced vascular radiology at the San Martin University Hospital in La Plata, before moving to the University of Texas Health and Science Center at San Antonio. Palmaz developed his stent, the first balloon-expandable stent, between 1978 and 1985 at UTHSCSA, and received a patent for his invention in 1988. It was approved by the FDA for peripheral arterial use in 1991, and for coronary use in 1994. Palmaz continues to innovate on his initial designs, developing new endovascular devices.

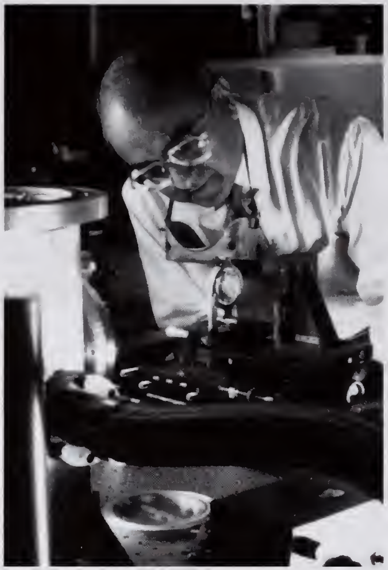

Photo credit: Courtesy of IBM

Rangaswamy Srinivasan

Far Ultraviolet Surgical and Dental Procedures

Patent No. 4,784,135

Born February 28, 1929

Inducted in 2002

In 1981, Rangaswamy Srinivasan discovered that an ultraviolet excimer laser could etch living tissue in a precise manner with no thermal damage to the surrounding area. He named the phenomenon Ablative Photodecomposition (APD).

Srinivasan and his co-inventors ran tests using the excimer laser and a conventional, green laser to etch organic matter. They discovered that while the green laser produced rough incisions, damaged by charring from the heat, the excimer laser produced clean, neat incisions. In 1983, Srinivasan collaborated with an ophthalmic surgeon to develop APD to etch the cornea. It resulted in a procedure to correct vision known today as LASIK surgery. Since the introduction of LASIK, millions of people have taken advantage of this procedure that reduces dependency on corrective lenses.

Srinivasan spent 30 years at IBM's T.J. Watson Research Center. Throughout his career, he has received many honors and awards and has been granted 21 U.S. patents. He received both bachelor's and master's degrees in science from the University of Madras, India, in 1949 and 1950, and earned a doctorate in physical chemistry at the University of Southern California in 1956. Today, he consults on lasers and laser applications.

Photo credit: National Inventors Hall of Fame®, Invent Now, Inc.

James J. Wynne

Far Ultraviolet Surgical and Dental Procedures

Patent No. 4,784,135

Born March 19, 1943

Inducted in 2002

James Wynne is co-inventor of a process using a short pulse ultraviolet laser to etch tissue in minute increments and in a highly controlled fashion. The technique, discovered with his colleagues at IBM, allows removal of material to a precisely determined depth without thermal damage to surrounding tissue.

Until the early 1980s, lasers were used in eye surgery to create scar tissue that had therapeutic value, as when welding a torn or detached retina. The excimer laser breakthrough is used for delicate surgical procedures, most notably refractive eye surgeries such as PRK and LASIK. LASIK (laser in situ keratomileusis) permanently changes the shape of the cornea, the clear covering of the front of the eye, using the excimer laser.

Born in Brooklyn, New York, Wynne attended Harvard University, receiving his A.B. in 1964, his M.A. in 1965, and his Ph.D. in 1969, all in physics. He joined IBM in 1969, worked in the Zurich Research Laboratory for one and a half years, then moved to the Watson Research Center in New York. He was manager of the laser physics and chemistry group when excimer laser surgery was discovered. The recipient of many IBM honors, Wynne has been involved with education outreach since the early 1990s. He is presently exploring new ways to apply laser technology to dermatology.

Photo credit: National Inventors Hall of Fame®, Invent Now, Inc.

Samuel E. Blum

Far Ultraviolet Surgical and Dental Procedures

Patent No. 4,784,135

Born August 28, 1920

Inducted in 2002

Samuel Blum was working with Rangaswamy Srinivasan and James Wynne at IBM's T.J. Watson Research Center when they observed the effect of the ultraviolet excimer laser on biological materials. Intrigued, they investigated further, finding that the laser made clean, precise cuts that would be ideal for delicate surgeries.

The laser technique they researched went on to become the foundation for LASIK (laser in situ keratomileusis) eye surgery. In LASIK, the shape of the cornea is permanently changed using the excimer laser. Adjustments can be made for nearsightedness, farsightedness, and astigmatism. Well over two and a half million people in the United States have undergone LASIK surgery. Born in New York, Blum spent most of his school years in Piscataway, New Jersey before attending Rutgers University. Shortly after graduating with his B.S. in chemistry in 1942, Blum was commissioned by the U.S. Navy where he was certified in meteorology and weather forecasting. After his time with the Navy, Blum received a Ph.D. in physical chemistry from Rutgers in 1950.

Blum worked at Batelle Memorial Institute for several years before joining the Watson Research Center, staying there for 31 years until his retirement. Prior to his work with the excimer laser, Blum's focus was on semi-conductor compounds.

Photo credit: Courtesy of NPL © Crown Copyright 1974.

Donald Watts Davies

Apparatus and Methods for Granting Access to Computers

Patent No. 4,799,258

Born June 7, 1924
Died May 28, 2000

Inducted in 2007

Donald Davies' crucial breakthrough of packet switching, which enables the efficient exchange of information between computers, makes modern computer communications both functional and robust.

Born in Treorchy, Wales, Davies studied at the Imperial College in London, earning his B.S. in physics and mathematics. Following graduation, he worked at the National Physical Laboratory in England pursuing ways to broaden the use of computers. In 1965, Davies designed and implemented the first operational packet switching network. Packet switching, a term coined by Davies, was based on the concept of sending information in small digital "packets" through a distributed system, with each packet able to take a different path from sender to receiver, rather than over a conventional dedicated circuit.

After proving packet switching's feasibility in the United Kingdom, Davies worked with the Advanced Research Projects Agency in the U.S. to create a larger, universal network. Davies' concept of breaking up packets of information was quickly implemented in ARPANET, the precursor to the Internet.

Digital packet switching enabled data networks to have greater flexibility and throughput while providing the basis for TCP/IP, the Internet Protocol.

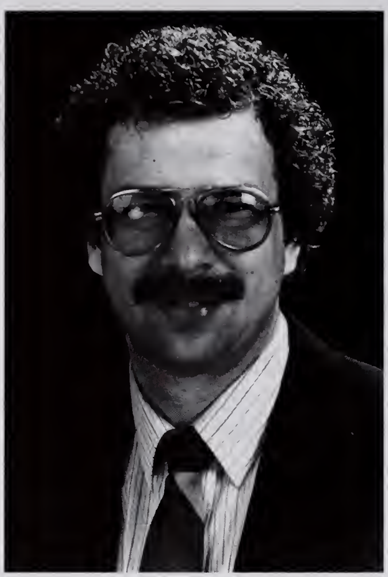

Photo credit: Courtesy of San Jose Mercury News

Ross Freeman

Configurable Electrical Circuit Having Configurable Logic Elements and Configurable Interconnects

Patent No. 4,870,302

Born July 26, 1948
Died October 22, 1989

Inducted in 2009

Ross Freeman invented the field programmable gate array (FPGA), a computer chip full of "open gates" that engineers can reprogram as much as needed to add new functionality, adapt to changing standards or specifications, and make last minute design changes.

At the time, Freeman correctly postulated that the cost of transistors would steadily decrease over time, due to Moore's Law (doubling of transistor density every two years), making the FPGA an affordable and flexible alternative to custom chips for a wide range of applications.

In 1984, Freeman co-founded Xilinx, Inc. based upon an invention that would not only lay the foundation for a new company but an entirely new industry. Today, Xilinx commands more than 50 percent market share in the multi-billion programmable logic device (PLD) industry. Its chips are used in a variety of end markets – including automotive, consumer, industrial, medical, aerospace / defense, and wired / wireless communications – for applications ranging from automotive infotainment, driver assistance and flat panel displays to medical imaging, video surveillance and wireless base stations.

Prior to founding Xilinx, Freeman worked for Zilog, Inc., and Teletype Corporation. He earned a bachelor's degree in physics from Michigan State University in 1969 and a master's from the University of Illinois in 1971. Before starting his professional career, Freeman was a Peace Corps volunteer, teaching math and electronics in Ghana.

Photo Credit: Pall Corporation

David Pall

Depletion of the Leukocyte Content of Blood and Blood Components

Patent No. 4,925,572

Born April 2, 1914
Died September 21, 2004

Inducted in 2008

David Pall received over 181 patents in the field of filtration. Among his most important inventions was a leukoreduction filter which makes blood transfusions safer.

Born in Thunder Bay, Canada, Pall decided to be a chemist when he was 11. He graduated from McGill University in 1939 with a B.S. degree and a Ph.D. in physical chemistry. During World War II, Pall helped develop a filter critical to the Manhattan Project. In 1946, he set up what would become Pall Corporation in a Queens, New York garage to commercialize his filtration knowledge.

In the late 1950s, oil filters on automobiles were also on passenger jets. Planes were grounded after the landing gear failed on several commercial flights due to contamination. Pall created a woven metal filter that removed the impurities jamming the hydraulics. He later developed a filter to purify jet fuel. His company became the leading supplier of aerospace filters.

Pall turned to transfusion medicine when he learned his wife's body would eventually reject the blood transfusions she needed to live. He developed an in-depth understanding of human blood, and invented the leukocyte reduction filter that has raised the standard of care for patients around the world.

Photo credit: Texas Instruments

Larry Hornbeck

Spatial Light Modulator and Method

Patent No. 5,061,049

Born September 17, 1943

Inducted in 2009

Larry Hornbeck is the inventor of the Digital Micromirror Device, an array of up to two-million hinged microscopic aluminum mirrors on a silicon chip. Under digital control, these tiny mirrors tilt thousands of times a second to create an image by directing pulses of "digital" light through a projection lens and onto a television, presentation, or movie theater screen.

The trademarked DLP technology from Texas Instruments uses this versatile imaging technique in products ranging from tiny pico projectors embedded in cell phones to TI's DLP Cinema projectors that light up more than 8,000 theater screens around the world. A variety of non-display applications are enabled as well.

Born in St. Louis, Hornbeck received a Ph.D. in physics from Case Western Reserve University in 1974. He joined TI in 1973 and invented the DMD in 1987 after struggling for a decade to perfect analog micromirrors. He holds a series of patents that form the foundation for DMD technology, including the first practical methods for manufacturing high-density arrays of micromirrors on an integrated circuit. Among his many accolades, Hornbeck received an Emmy Award in 1998 from the Academy of Television Arts & Sciences.

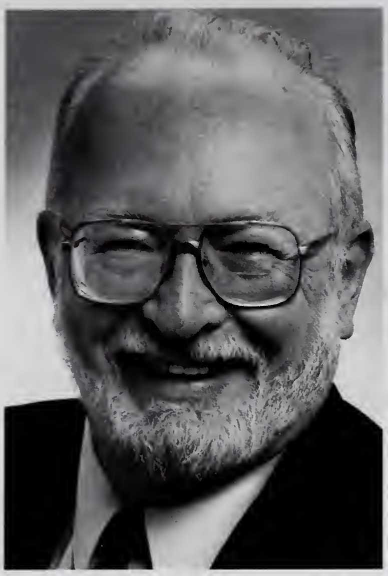

Photo credit: ©The Nobel Foundation

Paul Christian Lauterbur

Method for Calculating Localized Magnetic Resonance Spectra from a Small Number of Spatially-Encoded Spectroscopic Signals

Patent No. 5,081,992

Born May 6, 1929
Died March 27, 2007

Inducted in 2007

By developing the use of nuclear magnetic resonance (NMR) to create images of organs, joints and other tissues in the human body, Paul Lauterbur established magnetic resonance imaging (MRI) as an important tool in modern medicine.

Born in Sidney, Ohio, he earned his B.A. in chemistry from the Case Institute of Technology and his Ph.D. from the University of Pittsburgh. Early in his career, Lauterbur pursued the use of NMR machines to study the structure of chemical compounds while working for the Army Chemical Center Medical Laboratories. Applying a magnetic field, he was able to determine spatial patterns within chemical compounds. Lauterbur furthered his research on NMR spectroscopy at the State University of New York at Stony Brook, refining methods for analyzing structures. By determining NMR technology could be used to create images of structures within the body, he created a uniform magnetic field to provide resolute signals. MRI provides detailed images of internal organs, making it a valuable tool for spotting cancerous tumors, internal injuries and defects in tissue.

While at the University of Illinois at Urbana-Champaign, Lauterbur continued his work pursuing new applications for bioengineering. Recipient of many honors, he was awarded the 2003 Nobel Prize.

Photo credit: ©Peter Menzel www.menzelphoto.com

Leroy Edward Hood

Automated DNA Sequencing Technique

Patent No. 5,171,534

Born October 10, 1938

Inducted in 2007

By developing several automated biotechnical instruments, Leroy Hood played a crucial role in the biotech industry. His DNA gene sequencer greatly accelerated the Human Genome Project during the 1990s. By enabling scientists to map the 25,000 genes that make up a human being, Hood revolutionized biomedical research.

While pursuing his Ph.D. at the California Institute of Technology, he became inspired to develop a machine that would automate protein sequencing. Hood and his team created a machine one hundred times more sensitive than previous devices and allowed scientists to analyze proteins previously impossible to isolate in large amounts.

Hood and his colleagues also developed a protein synthesizer, which enabled the production of long proteins in high, consistent yields, and a DNA synthesizer which made it practical to synthesize DNA fragments for use in sequencing and cloning even complete genes. He also developed the ink-jet synthesizer which synthesized DNA chips.

Born in Missoula, Montana, Hood earned his M.D. from the Johns Hopkins School of Medicine and his Ph.D. from Caltech. He is the recipient of many awards including the Lasker Award, the Kyoto Prize, and the Lemelson-MIT Prize.

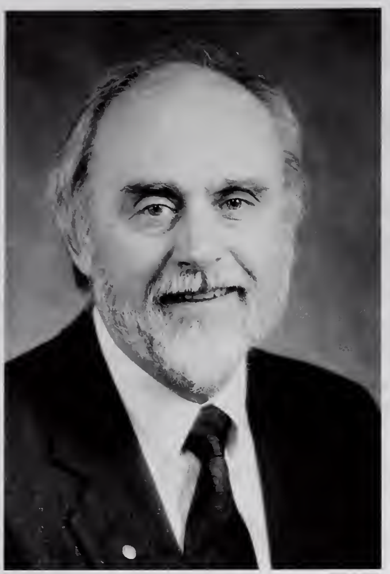

Photo credit: 3M

Arthur L. Fry

Repositionable Pressure-Sensitive Adhesive Sheet Material

Patent No. 5,194,299

Born August 19,1931

Inducted in 2010

Art Fry was a new product development researcher at 3M when he learned of the adhesive microspheres that his colleague Spencer Silver had developed. The spheres were pressure-sensitive, but had a low degree of adhesion. He coated paper with the adhesive and made repositionable notes, and the concept of Post-it® Notes was created.

Years of perfecting design and production followed. Major challenges involved creating equipment and processes to manufacture the notes, as well as the problem of getting the adhesive to stay in place and maintain a consistent range of adhesion.

Post-it Notes were introduced nationally in the United States in 1980. Repositionable notes are now among the five best-selling office products in the U.S., and when 3M received the National Medal of Technology in 1995, Post-it Notes were named among the products that helped the company earn the award.

Born in Owatona, Minnesota, Fry graduated from the University of Minnesota and spent his career at 3M until his retirement in 1992. He made many technical contributions to 3M products, including art materials, tapes, decorative ribbon and gift wrap, and metal surface-finishing laminates. He was admitted into 3M's Carlton Society in 1983, the highest honor given to a 3M scientist.

Photo credit: Douglas Levere, University at Buffalo

Esther Sans Takeuchi

Preparation of Silver Vanadium Oxide Cathodes Using Ag(0) and V_2O_5 as Starting Materials; Alkali Metal Electrochemical Cell Having an Improved Cathode Activated with a Nonaqueous Electrolyte Having an Organic Carbonate Additive

Patent Nos. 5,389,472; 6,221,534

Born September 8, 1953

Inducted in 2011

Energy storage expert Esther Takeuchi led efforts to invent and refine the lifesaving lithium/silver vanadium oxide (Li/SVO) battery technology, utilized in the majority of today's implantable cardioverter defibrillators (ICDs).

ICD batteries have high energy density with the ability to support intermittent high-power pulses. In addition, they have a long life, are safe, and durable.

In Takeuchi's innovation, the cathodes employ two metals, silver and vanadium, rather than just one, allowing for more energy. In addition, the Li/SVO chemistry lets the ICD monitor the level of discharge, allowing it to predict end of service in a reliable manner.

Takeuchi's work was conducted during 22 years at Greatbatch, Inc., a major supplier of pacemaker and ICD batteries. Today, over 300,000 ICDs are implanted every year.

Raised in Ohio, Takeuchi received her B.A. from the University of Pennsylvania and her Ph.D. from The Ohio State University. She joined Greatbatch, Inc. in 1984, and in 2007, she joined the University at Buffalo where she is SUNY Distinguished Professor and the Greatbatch Professor of Advanced Power Sources. She has received over 140 U.S. patents and is the recipient of the 2008 National Medal of Technology and Innovation.

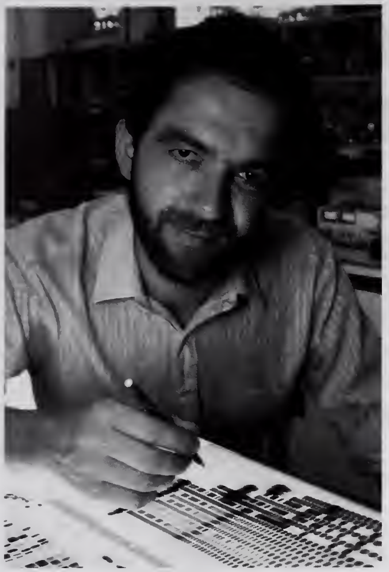

Photo credit: ©British Council 1989

Alec Jeffreys

Method of Characterizing Genomic DNA by Reference to a Genetic Variable

Patent No. 5,413,908

Born January 9, 1950

Inducted in 2005

Alec Jeffreys invented genetic fingerprinting, a powerful technology that provided new insights for genetic researchers, and resolved life-or-death questions for law enforcement. It also provided a simple way to establish family relationships in paternity and immigration disputes, screen for mutations, identify human remains, and improve animal breeding.

Human DNA contains long strands of molecules that correlate to each individual's genetic traits. The amount of information coded into DNA is so vast that it is difficult to examine DNA samples. Jeffreys discovered a process that detects extremely variable DNA regions, proving that each human has its own genetic fingerprint. Users of genetic fingerprinting were able to pursue and identify criminals who left behind samples of blood, semen, skin or hair after a crime. Subjecting these DNA samples to genetic fingerprinting made it possible to conclusively link suspects to the scene of a crime. It also exonerated numerous people falsely convicted before genetic fingerprinting was invented.

Born in Oxford, England in 1950, Jeffreys studied at Merton College in Oxford. He conducts his research at the University of Leicester, where he made his well-known discovery. His work has earned him numerous honors, including knighthood in 1994.

Photo credit: Courtesy of Dr. Eric Fossum

Eric R. Fossum

Active Pixel Sensor with Intra-Pixel Charge Transfer

Patent No. 5,471,515

Born October 17, 1957

Inducted in 2011

Eric Fossum led the team at NASA's Jet Propulsion Laboratory that created a miniaturized camera technology known as the CMOS active pixel sensor camera-on-a-chip. Today, CMOS image sensors are a fixture in imaging.

In 1990, Fossum joined JPL to bolster image-sensing research for space applications. To reduce power and size of CCD cameras for interplanetary spacecraft, he used CMOS technology to put all necessary technology on one chip. Each chip contained arrays of light-sensitive pixels, each with its own amplifier. Circuits within the chip allowed functions like noise reduction, analog-to-digital conversion, and digital image processing.

Fossum and JPL co-workers formed Photobit Corporation in 1995, which was eventually acquired by Micron in 2001. Worldwide annual revenue for the technology is estimated to reach $6 billion in 2011.

Over 90% of camera phones use the CMOS image sensor technology.
The CMOS sensor market continues to grow with applications that include digital SLR cameras, embedded web-cams, video cameras, automotive safety systems, swallowable pill cameras, toys and video games, and wireless video-security networks.

Born in Connecticut, Fossum received his B.S. from Trinity College, and his M.S. and Ph.D. from Yale. He was with Columbia before conducting his CMOS work at JPL and recently joined the faculty at Dartmouth College.


Photo credit: ©2002 Toerge, Black Star

Bradford Parkinson

System and Method for Generating Precise Position Determinations

Patent No. 5,572,218

Born February 16, 1935

Inducted in 2004

Bradford Parkinson developed the Global Positioning System, a locational and navigational system that allows users to determine their location with great accuracy. GPS makes use of signals transmitted by some of the 24 dedicated NAVSTAR satellites circling the globe in precisely defined orbits. Using the satellites as reference points, GPS receivers calculate positions based on the difference in arrival time of signals from the different satellites. Although GPS was initially developed for the U.S. military in order to guide missiles to targets, it is now routinely used for air traffic control systems, ships, trucks and cars, mechanized farming, search and rescue, tracking environmental changes, and more.

Parkinson created and ran the NAVSTAR GPS Joint Program Office from 1972 to 1978. As the program's first manager, he has been the chief architect of GPS throughout the system's conception, engineering development, and implementation.

Born in Wisconsin, Parkinson received his B.S. in general engineering at the U.S. Naval Academy in 1957, and his M.S. in aeronautics and astronautics from MIT in 1961. In 1966, he received his Ph.D. from Stanford University in aeronautics and astronautics. Parkinson is the recipient of many awards, including the 2003 Charles Stark Draper Prize, the IEEE Sperry Award, NASA's Distinguished Public Service Medal, and has been inducted into the NASA Hall of Fame.

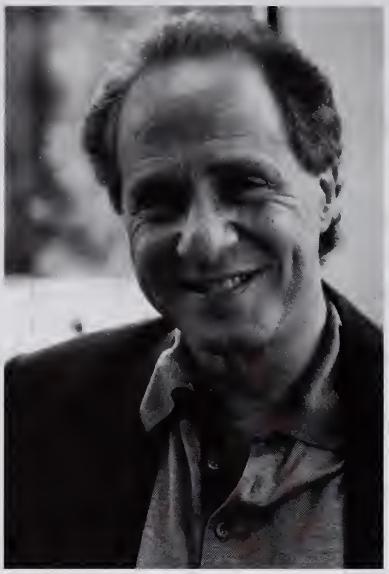

Photo credit: ©Michael Lutch/Courtesy Kurzweil Technologies

Raymond Kurzweil

Reading System

Patent No. 6,199,042

Born February 12, 1948

Inducted in 2002

Ray Kurzweil invented the Kurzweil Reading Machine, the first device to transform print into computer-spoken words, enabling blind and visually impaired people to read printed materials. When this print-to-speech reading machine was invented in 1976, the technology was regarded as the most significant advancement for the blind since Braille's introduction in 1829.

Kurzweil graduated from the Massachusetts Institute of Technology in 1970, majoring in computer science and literature. Several years later, he formed a company to explore pattern recognition technology such as Optical Character Recognition (OCR). He advanced the technology by developing the first omnifont OCR in 1974, creating software that understood letter shapes in any font. In conjunction with this, Kurzweil and the team he led also developed the first charge coupled device (CCD) flatbed scanner, the ubiquitous scanners in workplaces and homes. Other contributions include the Kurzweil 250 music synthesizer, which recreates the rich sounds of orchestral instruments.

Since 1973, Kurzweil has founded nine companies. A pioneer in artificial intelligence, he is the author of The Age of Intelligent Machines and The Age of Spiritual Machines. Honored by many awards, Kurzweil received the National Medal of Technology in 1999.

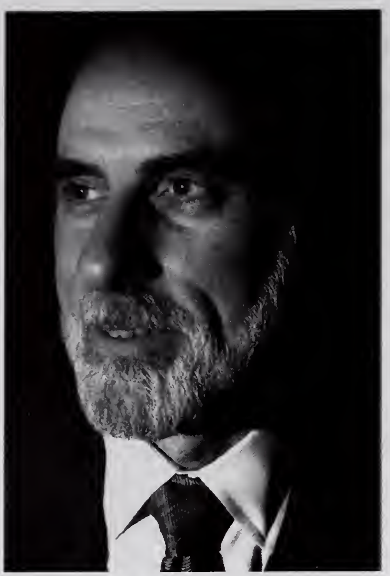

Photo credit: Dr. Vinton G. Cerf

Vinton G. Cerf

System for Distributed Task Execution

Patent No. 6,574,628

Born June 23, 1943

Inducted in 2006

Vinton Cerf and Robert Kahn designed the architecture of the Internet and the procedures known as the Transmission Control Protocol/Internet Protocol, or TCP/IP, that allow supercomputers and desktop PCs to share the Internet.

In 1968, the Defense Advanced Research Projects Agency sponsored the ARPANET project to link computers for resource sharing.

Robert Kahn envisioned the Internet as an open, accessible collection of networks operated cooperatively. Based on Kahn's Open Architecture concepts, Cerf and Kahn invented their first design they called TCP in 1974. The design allowed DARPA's Packet Radio, Packet Satellite and ARPANET networks to interconnect and interwork seamlessly. TCP/IP became the required way to use the ARPA-sponsored packet networks beginning in 1983. It allowed arbitrary collections of packet networks to evolve into the Internet, enabling applications ranging from e-mail, streaming audio and video to the World Wide Web.

Cerf was born in New Haven, Connecticut. He pursued his B.S. at Stanford University before earning his M.S. and Ph.D. at UCLA. National Medal of Technology recipients in 1997, and Presidential Medal of Freedom recipients in 2005, Cerf and Kahn are often referred to as the "fathers of the Internet."


Photo credit: Corporation for National Research Initiatives

Robert E. Kahn

System for Distributed Task Execution

Patent No. 6,574,628

Born December 23, 1938

Inducted in 2006

Robert Kahn and Vinton Cerf created the architecture for the Internet and collaborated on the design of software – known as the Transmission Control Protocol/Internet Protocol, or TCP/IP – that implements the architecture.

Born in Brooklyn, New York, Kahn earned his bachelor's degree in electrical engineering from the City College of New York before gaining his M.A. and Ph.D. degrees at Princeton University. Prior to joining the Defense Advanced Research Projects Agency, Kahn designed the first communication network, known as ARPANET, which was based on a new technique called "packet switching" that enabled heterogeneous distributed computers to exchange packets of data. In collaboration with Vinton Cerf, a computer scientist, he created the Internet architecture, which allows multiple heterogeneous networks (and their computers) to communicate with each other. Their work resulted in a protocol, now known as TCP/IP, that implemented key elements of the architecture. Beginning in 1983, TCP/IP became the standard host protocol on the ARPANET; it was one of the first three networks to be connected in the Internet, thus enabling applications ranging from e-mail and instant messaging to the World Wide Web.

In 2004, Kahn received the Turing Award with Cerf for their pioneering work on the Internet.

Photo credit: Courtesy of National Inventors Hall of Fame®, Invent Now, Inc.

Gary K. Michelson

Apparatus for Use in Inserting Spinal Implants

Patent No. 6,770,074

Born January 14, 1949

Inducted in 2011

Orthopedic spinal surgeon Gary Michelson has a portfolio of over 250 U.S. and 500 foreign patents related to spinal fusion and surgical implants. His inventions have advanced spinal surgery with minimally invasive procedures, devices, and surgical tools that are central to many spinal surgery systems. Annual sales for spinal devices currently exceed $4 billion.

Over 65 million Americans suffer from back pain, with over 650,000 surgeries performed each year. By age 50, over 85% of the population shows some sign of disc degeneration. Spinal fusion strives to prevent motion at the painful vertebral segment to decrease pain. Other conditions that may warrant spinal fusion are fractures, scoliosis, or a weak and unstable spine.

One of Michelson's devices is a threaded cage which is implanted between two vertebrae, then packed with bone graft. Recent methods for spinal fusion, including the use of a protein to encourage bone growth, eliminate the need for obtaining a bone graft from the patient.

Michelson, a native of Philadelphia, attended Temple University and Hahnemann Medical College. He began inventing tools and devices in his garage, and he eventually turned his hobby into Karlin Technology, Inc., a technology licensing company. He is now involved with the creation of an open architecture library of digital downloadable college textbooks.

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The USPTO also plays an important role in developing policies that will ensure that America's spirit of invention and creativity continues to thrive. Towards this end, the USPTO has joined Invent Now in sponsoring events, programs, and activities that provide recognition for inventors and inspire students at all levels to create and respect intellectual property.

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